SCIENCE LIBRARY
MAY 14 1917
UNIV. OF MICH.
LIBRARY

Engineering and Mining Journal

With which is consolidated Mining and Engineering World

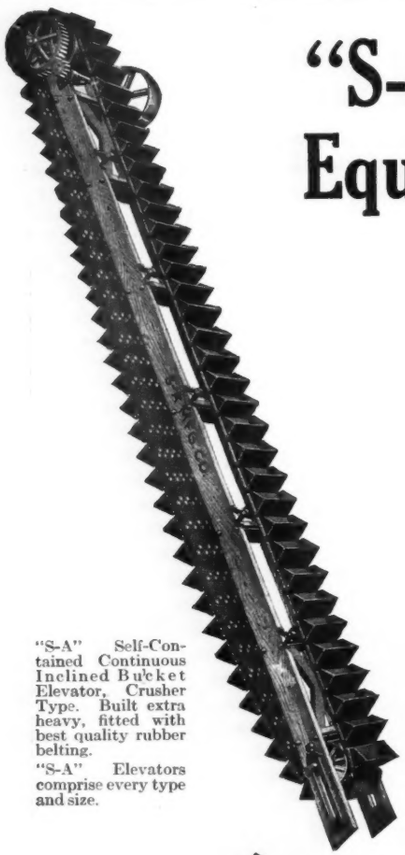
Volume 103, No. 19
Issued Every Saturday
McGraw-Hill Publishing Co., Inc.

NEW YORK, MAY 12, 1917

Price, 15 Cents
Contents, First Page
Advertising Index, Last Page

The S-A Page

Published Weekly in the Interests of S-A Conveying Engineering



"S-A" Self-Contained Continuous Inclined Bucket Elevator, Crusher Type. Built extra heavy, fitted with best quality rubber belting.

"S-A" Elevators comprise every type and size.

"S-A" Elevating and Conveying Equipment for this Big Plant

One of the largest zinc smelters in the West decided to standardize on "S-A" Handling System after their engineers had made a careful study of numerous installations in this country and in Europe.

Their decision was reached after careful technical deliberation. The equipment is arranged about as follows:

The raw ores are unloaded from the cars by an "S-A" Power Shovel, then elevated by an "S-A" Bucket Elevator and finally distributed to the crushing rolls by "S-A" Belt Conveyors.

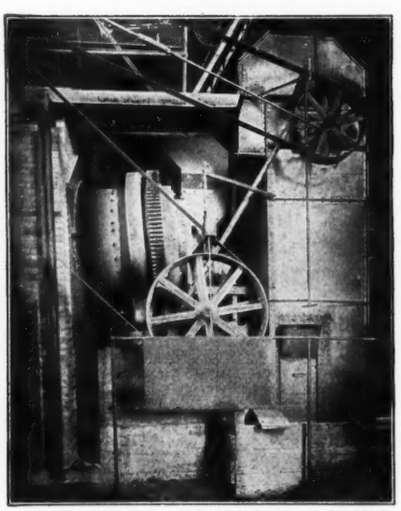
The fine ores are drawn from the bins on to industrial cars which carry it to "S-A" Elevators. The latter deliver the ore to "S-A" Conveyors which distribute it to the bins above the roasting kilns.

The roasted ore mixed with hard coal is delivered by "S-A" Bucket Elevators and "S-A" Belt Conveyors to the furnace bins.

Coal for the furnace gas producer plant is handled from a track hopper through an "S-A" Apron Feeder to an "S-A" Crusher, discharging on to an "S-A" Shuttle Type Belt Conveyor distributing to the overhead bunkers.

The "S-A" engineers would like to discuss any special ore, coal, rock, cement or other bulk material handling problem. Their services are yours for the asking. Write for Bulletin now.

THE TWO ELEVATORS SHOWN DELIVER THE FINE ORE TO THE ROASTING KILNS



ELEVATOR NO. 1 DELIVERING TO DRYER

Stephens-Adamson Mfg. Company - Aurora, Illinois

Conveying, Screening, Transmission Machinery

Branch Offices:

50 Church St., NEW YORK
First National Bank Bldg., CHICAGO
79 Milk St., BOSTON, MASS.
H. W. Oliver Building, PITTSBURGH
803 New Bank of Commerce Bldg., ST. LOUIS, MO.
1st Nat'l Bank Bldg., HUNTINGTON, W. VA.
824 Dime Bank Bldg., DETROIT, MICH.
310 Star Bldg., TORONTO, CANADA
412 East Third St., LOS ANGELES
503 Dooly Block, SALT LAKE CITY

Australian Agent—Arthur Leplastrier & Co., Circular Quay East, Sydney.
South African Agent—J. Mac G. Love & Co., Limited, 1 and 3 London House, Loveday St., Johannesburg

Engineering and Mining Journal

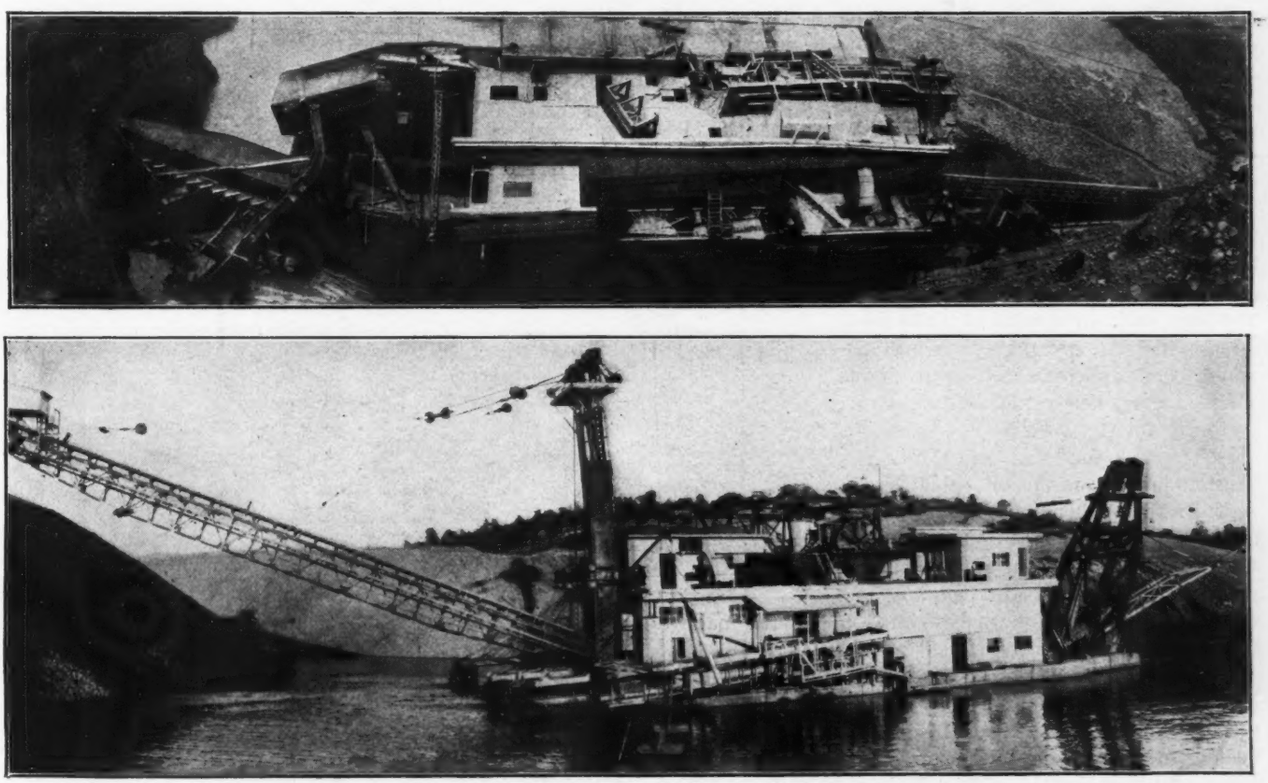
VOLUME 103 MAY 12, 1917 NUMBER 19

Righting a Wrecked Gold Dredge

By Lewis H. Eddy*

SYNOPSIS—No. 7, all-steel gold dredge, owned and operated by the Natomas Co., of California, was sunk in April, 1916, righted at a cost of $108,248, in six months 11 days elapsed time, and resumed digging in October. The righting and repairing was done by the engineering and shops department of the company at Natoma.

Natoma No. 7 gold dredge was turned over and sunk in 52 ft. of water in Blue Ravine field, Natoma division, American district, California, at 3 a.m. Apr. 1, 1916. Through neglect or absence of the stern oiler, who was probably asleep, the stacker belt had stopped and the door of the hatchway had been left open. The tailings from the revolving screen piled up on the end of the stacker, overflowed to the deck and fell through the hatchway opening into the stern hold on the port side. When converted from a wooden-hull to an all-steel dredge, in 1913, the design did not provide for adequate freeboard especially when the digging ladder was low, the stern of the boat sinking below the water line and the bow showing only small freeboard. In February, 1914, wooden pontons were installed fore and aft, providing more satisfactory buoyancy, but even with this improvement it did not require a great amount of rock in the hold to sink the stern sufficiently to allow the water to flow freely through the hatchway and rapidly sink the dredge. The small freeboard would also make it hard for a man at the other end of the boat, especially the winchman, to notice the small list of the stern.



UPPER—CAPSIZED DREDGE AFTER WATER IN POND HAD BEEN PARTIALLY PUMPED OUT. LOWER—DREDGE RIGHTED, REPAIRED AND AGAIN IN OPERATION

After the listing of stern to port was noticed, the winchman dropped both spuds and endeavored to raise the digging ladder, which would throw the stern up and the bow down. But there was not sufficient time to raise

*Associate editor, 3430 Peralta St., Oakland, Calif.

the ladder far above the water line. From the moment the winchman noticed the listing to the time it was necessary to flee to safety, less than 10 min. had elapsed, which was sufficient for dropping the spuds but not sufficient to hoist the ladder to a position that would right the stern and place the hull on an even keel and stop the flow of water into the hold.

The ladder stuck in the bank in which it had been digging, and the dredge pivoted with this point as a center, turning over through an angle of 120 deg., so that the bottom of the hull showed an angle of 30 deg. with the vertical. It probably would have turned turtle completely but for the fact that the upper works rested against a tailings pile on the port side. The dredge was digging, at the time of the accident, on the port side of a double cut and against an 18-ft. bank, the depth from water line to bedrock varying from 49 ft. to 60 ft., making a maximum digging depth of 78 ft.

The first step taken to right the dredge was to pump the water down a few feet. While this work proceeded, the dredge was still changing position. The deadmen were put in place as quickly as possible, being covered about Apr. 11-12. The main deadman, was made up of an old wooden spud, 34 x 54 in. by 60 ft., and buried in 12 ft. of gravel between two tailing piles, the one in front of the deadman being about 20 ft. high. The auxiliary deadman was a timber 24 x 30 in. by 22 ft., buried in 12 ft. of gravel. The deadmen set in the tailings piles were covered by the use of a dragline scraper. The main lines fastened to the dredge consisted of five 2½-in. galvanized bridge-suspension cables with wire centers, figured to be strong enough to pull a maximum of 250 tons each, or a total of 1250 tons, almost the full weight of the dredge which was approximately 1600 tons. Each main deadman pennant line fastened to the 34 x 54-in. by 60-ft. deadman was made up of 2½-in. galvanized bridge-suspension cable or 1½-in. dredge ladder-hoist lines, with enough laps to equal the strength of the 2½-in. cable. Each main tackle placed between the main pennant and deadman pennant, consisted of an 8-part block made up from 1¼-in. special steel ladder-hoist line.

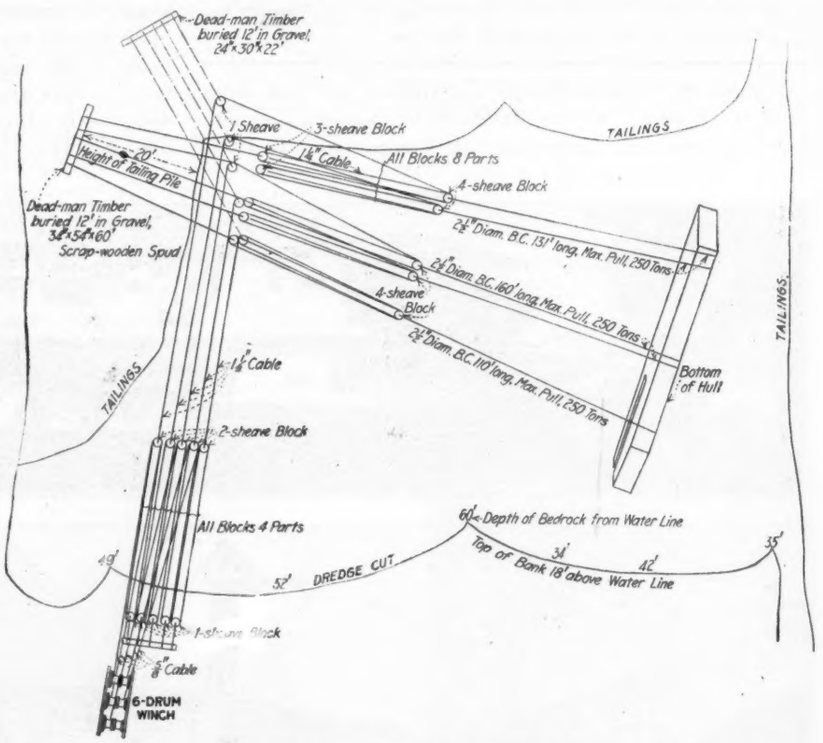
The jig tackle, which was fastened to the hauling line from the main tackle, was placed at about right angles to the main tackle. Each 1¼-in. hauling line was deflected to this angle by means of a one-sheave block fastened by a line to a 24 x 30-in. by 22-ft. deadman which, as stated, was also buried in the tailings pile. These jig tackles consisted of four-part blocks, using ⅝-in. standard plow-steel hoisting cable. The hauling lines from these tackles were fastened to the several drums of a side-line winch, electrically driven, taken from Natoma No. 1 dredge which was being rebuilt at the time. This winch was fastened to a wooden foundation buried several feet in the virgin ground as was also the deadman for the jig tackles.

The first set of lines was finished and fastened to the dredge about Apr. 20. In the meantime, as the lines were being put in and the slack taken out of them, the water was being pumped out of the pond. The first main pull was attempted on Apr. 22. At this time there were only four main fastenings to the hull of the dredge. The fastening at the stern end, being single, broke in this pull. The break was repaired and another set of fastenings added to the stern. This made a total of five fastenings, as shown in the illustration.

After the first main pull on Apr. 22, the broken line having been repaired and a new set put in, the slack was taken up each day as the pumping out of the pond water continued.

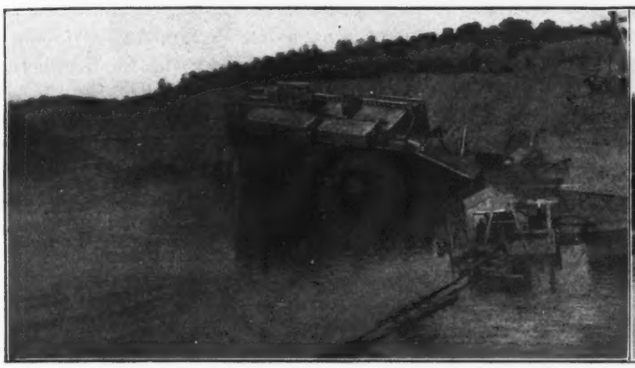
About May 1 all the water was out of the pond, the bottom of the dredge having been lifted only a few degrees toward the vertical. From May 1 to about May 25 the time was chiefly occupied in dismantling the dredge. About half of the digging ladder was removed by cutting in several places with an oxyacetylene blowtorch and half the buckets were taken off the line. Both spuds were thrown out of place, and the stacker was removed. The bow gantry was also cut with oxyacetylene blowtorch and most of it removed. During the time from May 1 to 25 the bottom of the hull was scraped and painted with one coat of bitumastic solution and one coat of bitumastic enamel. While this work was in progress, the bottom of the pond was leveled for a sufficient space and covered with sand and slickens to provide a bed for the dredge to rest on when the final pull was made. On May 25 the water was again turned into the pond, and everything was in readiness for the final pull on May 27.

The dredge was completely righted between 5 and 6 o'clock in the afternoon of May 27. When pulled over

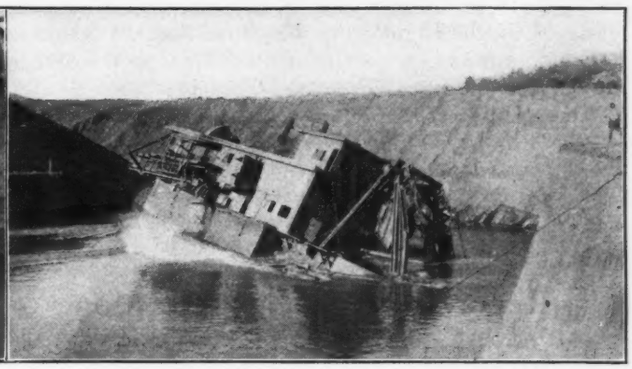


ARRANGEMENT OF TACKLE FOR RIGHTING DREDGE

to its proper position, the hull did not float, because the under, or port, side was damaged and could not be repaired during the progress of pumping out and refilling the pond. However, the water was only deep enough to cover the deck of the port side, which was then the lower part of the dredge, so that it was necessary to pump the pond down a few feet in order to make the repairs. Before the repairs were completed, all the remaining heavy pieces of damaged machinery were removed, including the remainder of the digging ladder and bucket



DREDGE READY FOR FINAL PULL



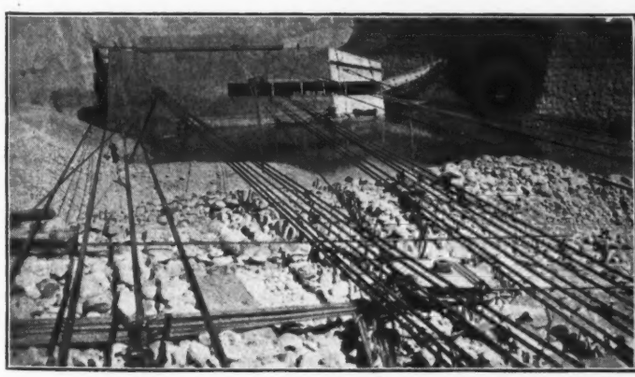
BOTTOM OF DREDGE STRIKING WATER ON FINAL PULL

line, pumps, etc. The dredge was then floated and moved over to a point where it would settle on the bed or bench of sand, and slickens were prepared for it; and the pond was pumped down to a dry bottom. In this position the remainder of the repairs were made. When the dredge was righted, there was no damage done by the bottom striking on the water or sand bed, as the pull was slow and the dredge hauled over gradually until within a few feet of floating position.

Examination of the hull where exposed above the water disclosed that the results of pitting did not require the replacing of any of the plates. Several cases of pitting were found, but they were not vital and not so numerous and serious as had been expected for the time the steel had been in the water—nearly three years. The pitting was mostly toward the stern and in the well-hole. The maximum depth of the pits was $\frac{1}{16}$ in. The steel was thoroughly cleaned and given a coat of bitumastic solution and a coat of bitumastic enamel. This paint material was used also on No. 4 dredge. Before deciding upon its use for dredge work, it was given complete and satisfactory tests by the company.

Nearly every truss part, especially on the port side, had been damaged to some extent, and it was quite a problem as to how far to go with repairs. In some places the parts were replaced entirely; in others they were patched up, care being taken that the repaired parts were made much stronger than the original section. The port side of the hull was badly damaged. It was necessary to remove a great many of the plates and frames, straightening out some and replacing a portion of them with new ones. The entire housing and gold-saving tables on the port side had to be replaced on account of having been cut off while the dredge was being righted in order to cut out as much weight as possible; this portion of the dredge was badly damaged. The original housing was made up of a combination of paper and thin steel sheets. The tables were of wood with steel supports. All this material was replaced with wooden structure.

The digging ladder was badly twisted in three or four places, and it was necessary to rebuild some new sections in the Natomas shops. The remainder of the ladder repairs were made in the field. The upper and lower ends of the tailings stacker had to be replaced. About 50% of the bow gantry had to be replaced. The lower 30 ft. was a total wreck. The stern gantry was in much worse shape than the bow gantry. These two parts and the main drive crane supports were what kept the dredge from turning turtle when it sunk. The dredge was strengthened throughout, and several additions were made, especially the heavy spud-keep casings. The bucket idler, slightly damaged, was repaired and returned to its place. The remainder of the work was along the



SHOWING ARRANGEMENT OF TACKLE FOR RIGHTING DREDGE AND THE OLD SPUD USED FOR A DEADMAN

lines of regular routine dredge construction. Fortunately, the installation of a new stacker belt had been delayed by the congestion of freights and the old belt could not be estimated among the losses, nor could the damage to the wooden pontons be seriously considered, as their replacement by steel ones was a practical and valuable improvement. The old wooden ones had been in service since the summer of 1914. The new steel pontons are of like dimensions and are each 70 ft. 8 in. long, 10 ft. 8 in. deep, 7 ft. wide. The length is divided by the center line of the upper tumbler into two sections of 31 ft. 11 in. forward and 38 ft. 9 in. aft. They were designed by the engineering department of the Natomas Co. and built and shipped in small sections to the dredge by the Ralston Iron Works, San Francisco.

The gold recovery was taken off the dredge in process of the regular cleanup on the afternoon prior to the wreck, so only a small amount of amalgam was lost. The repaired dredge was started again on Oct. 12, 1916, and has been digging steadily since.

Report of Copper Production

This table is compiled from reports received from the respective companies (except in the cases noted by asterisk as estimated), together with the reports of the United States Department of Commerce as to imported material, and in the main represents the crude-copper content of blister copper, in pounds.

	January	February	March	April
Alaska shipments	2,516,372	15,013,539	10,959,696	.....
Arizona:				
Arizona Copper	4,100,000	4,600,000	5,000,000	.....
Cons. Ariz. Smelting	‡	‡	1,750,000	
Inspiration	11,600,000	10,250,000	11,100,000	11,400,000
Miami	5,020,370	4,210,780	5,217,900	5,128,195
Old Dominion	3,000,000	2,695,000	3,335,000	3,516,000
Ray	7,767,663	7,177,898	8,006,843	.....
Shannon	759,000	888,000	950,000	924,000
Other Arizona	30,196,785	35,174,605	30,394,138	.....
California:				
Mammoth	2,200,000	2,200,000	2,000,000	1,850,000
Michigan:				
Calumet & Hecla	14,103,126	13,162,007	14,949,919	.....
Other Lake Superior*	9,500,000	9,000,000	9,500,000	.....
Montana:				
Anaconda	28,250,000	25,000,000	31,300,000	29,300,000
East Butte	1,479,520	1,460,440	1,597,340	2,081,080
Nevada:				
Mason Valley	†	†	1,821,695	.....
Nevada Cons	6,279,432	5,708,214	6,864,675	.....
New Mexico:				
Chino	6,452,154	6,572,106	6,200,851	.....
Utah:				
Utah Copper	13,913,811	13,459,829	15,512,676	.....
Eastern smelters*	2,670,370	2,039,390	2,762,825	.....
Total reported	149,808,603	158,611,808	167,473,548	.....
Others, estimated	24,850,000	25,150,000	24,618,000	.....
Total United States	174,658,603	183,761,808	192,091,548	.....
Imports in ore and concentrates	12,916,700	13,782,019	.....	.....
Imports in blister, etc	45,708,518	24,348,811	.....	.....
Grand total	233,283,821	221,892,638	.....	.....
British Columbia:				
B. C. Copper	331,667	314,274	406,072	.....
Granby Cons	2,946,476	2,580,288	3,901,398	.....
Mexico:				
Boleo	1,983,080	1,598,240	1,984,080	.....
Cananea	5,700,000	5,100,000	5,500,000	4,730,000
Other Foreign:				
Braden	4,798,000	3,450,000	5,942,000	.....
Cerro de Pasco	6,172,000	5,352,000	6,074,000	5,936,000
Chile	7,756,000	6,056,000	8,714,000	.....
Cape Copper	398,720	329,280	387,520	.....
Kyshtim	1,131,200	1,178,240	5,102,000	.....
Katanga	3,297,280	130,100	5,996,510	5,070,580

* Estimated. † Operation started in February. ‡ Included in "Other Arizona."

The grand total, which in the case of January was 233,283,821 lb., includes, under "Imports in ore and blister copper" the production of such companies as British Columbia, Granby, Cananea, Braden, Cerro de Pasco and Chile. As a matter of record, however, the figures of the latter are given after the total. We also report the production of the Boleo, Cape Copper, Kyshtim and Katanga companies, whose copper does not come to the United States.

The item "Alaska shipments" gives the official figures of the United States Department of Commerce and is supposed to include Kennecott, which is not reported separately. In some months all of the Kennecott production apparently is not shipped; for example, in January, the company's production was 7,800,000 lb., whereas Alaska shipments are reported as 2,516,372. Of course the difference will appear in later reports, the Kennecott production in February being 7,090,000 lb., and Alaska shipments, 15,013,539. Kennecott production in March was 7,076,000 lb., and in April, 7,180,000 lb.

Activity of the Bureau of Mines

WASHINGTON CORRESPONDENCE

Metallurgical experimentation in Idaho has been limited and delayed by the failure of State legislation to provide funds for coöperation with the United States Bureau of Mines, which recently established a station at Moscow through a coöperative agreement with the University of Idaho. Dorsey A. Lyon, the superintendent of the Seattle experiment station, is in direct charge of all research work being done by the Government in the Northwest, has been in Washington working out the plans for the activities of the next year with Van H. Manning and F. G. Cottrell, the director and chief metallurgist, respectively, of the Bureau of Mines. Mr. Lyon is hopeful that the money necessary to carry out the Idaho work may be raised.

In contrast with the situation at Moscow are the active coöperative efforts being made by the Oregon Bureau of Mines and Geology and by the University of Utah. The Oregon bureau, in order to facilitate work, will move from Corvallis to Portland, June 1.

To take full advantage of the presence of the Bureau of Mines' experiment station at Seattle, the University of Washington is about to announce five fellowships in the following subjects: Electrometallurgical processes; beneficiation of coal and nonmetallic minerals; clay industries and ceramics; general problems affecting the ores and the mining industries of the state; development of metallurgical industries. Each of these fellowships pays an annual salary of $720. Mr. Lyon is enthusiastic as the result of the benefits that have accrued from similar fellowships at the University of Utah. Not only does the Government receive the benefit, at a very small expenditure, of the services of students eager to accomplish something but these men, after a year of service under Federal direction, carry into engineering practice the ethical standard that the Government attempts to maintain.

Indications are, according to Mr. Lyon, that operators in the Northwest will take advantage of the Bureau's offer to allow metallurgists in private employment to use the laboratories at the experiment station for their own experimentation. The only conditions attached to this work are that the results of these experiments be given to the public and that the materials necessary be paid for by the companies interested.

Drill Bits and Drill Steel for Metal Mining

By George H. Gilman*

SYNOPSIS—A study of the choice of machine-drill bits, material used and methods of tempering will do much to increase the efficiency of machine drills. Different classes of bits are described and compared, and diagrams showing striking lines of cutting edges are given. Tempering furnaces and methods of tempering are described. Pyrometer or compass used to determine proper heat for tempering. Inspection of drills before leaving sharpening shop is recommended.

It is with the object of assisting in the effort to place mining with rock drills on a higher plane that this paper has been prepared. The facts presented have been gained by observation of standard methods in different sections of the country, supplemented by a knowledge of the requirements for varying conditions under which rock is excavated, secured only through experimental and research work.

The great wave of scientific mining that is sweeping the country at the present time has resulted in a great deal of thought and study being given to the rock-drilling end

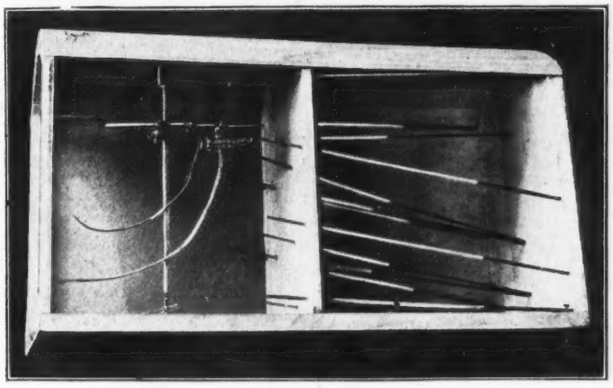


FIG. 1. MODEL TO SHOW DEPTH AND ANGLES OF DRILL HOLES

of the work, which is, beyond doubt, the "business" end of the whole proposition. The problem of determining the type and size of rock drill, its steel, mounting, hose and accessories best adapted to the existing conditions of ground is receiving serious consideration, supplemented by a study of the best methods for breaking ground, as regards the size and depth of drill hole, the number of holes, their relative position and angle, and the size, grade and amount of explosive required.

Furthermore, an effort is being made to minimize the personal equation which has always been a serious factor in the drilling operation. The importance of this is emphasized by the scarcity of skilled labor and the Workmen's Compensation Laws which prevail in all territories, together with the fact that the average mine manager is a humanitarian by virtue of his position and environment. This means that, so far as possible, the work of breaking ground is being made as simple and as easy for the workmen as the present state of the art will permit; summarized under the one word, efficiency.

*Sullivan Machinery Co., Claremont, N. H.

In view of obtaining desired results in this connection, it is recommended that the mine management seek the cooperation of the rock-drill manufacturer in determining the type and size of rock drill that meets, to the best advantage, the prevailing conditions of the work to be executed. A knowledge of the requirements of different grounds, considering the methods under which the work is to be executed, is gained only by experience and observation coupled with an intimate knowledge of rock-drilling machinery and modern rock-drill practice.

In general it may be said that the best type of rock drill for any condition is the one that will cut the greatest number of feet of drill hole in the least possible time with minimum exertion on the part of the operator and at minimum cost.

Primary Machine Factors Affecting Drilling Efficiency

The primary machine factors (eliminating hose, steel and mounting) that determine the efficiency of rock drilling are: Force and frequency of blow, speed and strength of rotation and ejection of cuttings or sludge from drill hole. Secondary factors are: Feeding and retracting the machine to and from its work, extracting stuck drill steel, changing drill steel, adequate lubrication for the machine and drill shank, means of all allaying dust, adjustability of machine to conform to variation in the alignment of the drill hole and convenience in handling.

The foregoing being the determining factors, it is doubtful if any are in better position to establish the requirements of a fixed set of conditions than the rock-drill expert of the manufacturer, who, by virtue of his work, has a training thrust upon him that enables him to make recommendations based on experience and observation.

It is a deplorable but nevertheless a well-known fact that no one type or size of the so-called standard rock drill will meet all conditions of ground and air pressure to the best advantage. In developing a standard machine all that it is possible for the rock-drill designer to do is to adapt it to meet to the best advantage the average conditions as he may have found them. It is then necessary to incorporate special features in the drill in order to have it meet more closely the conditions of the work that vary from the average, and on those special features the experts and salesmen of the manufacturer are informed, both as regards their make-up and function.

Too much emphasis cannot be placed upon the desirability of introducing scientific methods underground for breaking rock. It is folly to drill 20 holes in a heading if the same amount of ground may be pulled with 16. Furthermore, it is folly to assume that because a round of holes can be drilled in three hours, the drilling period is over. It is much better to so arrange the work that the drilling crew can put in two rounds of a shift's period, or the equivalent in footage by deepening the one round. In other words, the work should be planned so that the machine may be kept in operation for as great a portion of the shift's period as possible. When one considers the fact that under average present-day practice rarely more than 30% of the shift is consumed by

the drill in actually hammering upon the rock, it is unnecessary to elaborate upon the importance of minimizing the personal equation as applied to the operating of the drill.

Production is dependent on drill footage, but it is up to the mine management to see to it that the drill holes are properly positioned in order that the maximum amount of rock may be broken for the minimum amount of drilling. It is well in this connection to bear in mind that no more time is consumed in drilling a hole that is properly positioned and spotted than one that is drilled solely for the purpose of adding to the shift's footage regardless of its effect upon the ground. Disregarding the conditions under which rock drills operate, it is folly to use a larger or heavier mounting than is necessary to support the drill or drills without undue vibration, and it should be borne in mind that much lighter columns or bars are required for drills equipped with a pneumatic feed than for machines of the feed-screw type, owing to the fact that the pneumatic feed serves to absorb vibration by virtue of the air cushion provided in the feed cylinder.

In determining the size and weight of mounting required for drift or stope work in which the column type of support is employed, the following points should be considered: Width or height of working place measured from abutment to abutment; number of machines to be mounted on column; type and size of machine to be used; if a column arm is to be employed, the length of the arm; if a horizontal bar is used with or without arm, the desirability of employing a center leg brace to insure rigidity; hardness of the rock to be drilled; and air pressure.

Size, Depth and Angle of Holes

It is good practice to experiment in different grounds to determine the best size of hole, depth, angle and, above all, the number required to break the maximum tonnage with the least amount of drilling and with the minimum amount of powder. It should be the duty of superintendents, mine foremen and shift bosses to determine what may be accomplished in this direction and then to see to it that the miner is instructed accordingly. It is inadvisable to leave these points for the miner to decide. Remember that he is not as a rule in a position to analyze his troubles as well as his superior, nor is he able to study his work from as wide an angle. After these points are determined by experiment, they may be graphically impressed upon the men by using models which may readily be made from boards placed in proper position to represent the working face of the ground and with steel rods or wires placed in position to represent the position and angle of the drill holes required to properly break the ground. Such a model is illustrated by Fig. 1.

One of the most important points to determine in the breaking of ground is the smallest size of drill hole, at its bottom diameter, that will break successfully the burden imposed upon it. This will to a great extent govern both the size of drill and its drill steel. The character of the rock largely governs the strength of powder required and the type of rock-drill bit that may be employed to the best advantage, and both the character of the rock, the type of rock-drill bit and the length of the feeding means govern the variation in the gage of the bit or "drop" for each following length of drill steel. It is folly to use a drill steel of heavier section than is required to withstand without undue breakage the blow of the hammer drill required to cut the ground to the best advantage, for the larger the steel used the greater the absorption of energy in transmission to the rock, and furthermore, the size of the drill steel may govern the bottoming diameter of the drill hole. Where a variation in gage of $\frac{1}{32}$ in. between following steel is sufficient, the difference of $\frac{1}{8}$ in. or even $\frac{1}{4}$ in., not uncommon in practice, should be discouraged, for it must be remembered that the speed of drilling in rock is in direct proportion to the amount of rock removed from the drill hole and varies nearly inversely as the area of the drill hole. It is also apparent that the effectiveness of the drill hole in pulling the ground is determined solely by its bottom diameter, and when this is established, the less the variation in size between the bottom and its mouth the greater will be the speed of drilling and the lower the cost per unit of rock broken.

Proper Type of Drill Bits to Use

A great deal has been written in regard to the proper type of drill bit to employ for cutting rock, and it is a subject that is entitled to all the consideration it has received; but unfortunately this phase of mining has been woefully neglected, and today the old type of cross-bit is accepted by the majority of mining men as the standard for all conditions.

The essential qualifications of a rock-drill bit, regardless of the conditions under which it is operated, are that it must be made in such a manner that maximum cutting speed is maintained for as great a distance as possible before wear of the cutting edge reduces the speed of penetration to a point where a change of steel is made necessary; that the size or diameter of the drill hole corresponding to the gage of the bit is maintained with the least possible reduction as the depth of the hole increases; that the shape of the bit is such that it may be correctly formed and tempered with the least amount of exertion on the part of the forge smith.

As the type of rock-cutting bit for hammer-drill service that will meet to the best advantage any fixed set of conditions is determined only by a careful investigation in which force and frequency of the blow transmitted to the bit, speed and strength of rotation imparted to the drill steel, the character of the rock as regards hardness, abrasion and cohesion and the method to be employed for the ejection of sludge or rock cuttings are items on which all conclusions should be based. The following features of design should each receive individual consideration: Shape of the cutting edge; total length of cutting edge; angle of cutting edge; length and area of the reaming edges of surfaces; size and shape of clearance grooves for the ejection of rock cuttings; length and angle of the wings and the manner in which they are blended into the body of the steel; uniformity of metal adjacent to the cutting edges; adaptability of the bit to the available sharpening facilities.

The length of the cutting edge (by which is meant the combined length of the cutting edges) and the manner in which it is applied to the work form a determining factor in the drilling operation as regards speed and also as applied to the life of the drill steel and its actuating engine. We might naturally assume that within reasonable limits the longer the cutting edge the greater will be the amount of rock particles disengaged from the mass for every blow delivered and that a long cutting

edge would naturally be conducive to rapid drilling, but this applies only as long as the cutting edge remains sharp, which it naturally does for a longer period in soft, non-abrasive material than in hard, gritty or abrasive rock; but we must consider the effect of a dulled or blunt cutting edge, as the combined area of the blunt edge of all the cutting surfaces determines the cushioning resistance, which naturally governs the penetration per blow, and a decrease in penetration results in a lessening of the cushioning effect, which in turn has a tendency to cause the drill steel to rebound from the rock; this, when carried to excess, causes breakage of the drill steel, the hammer of the drill and, in the absence of an effective means to properly cushion the drill piston on its rearward stroke, breakage of other parts of the drill, including the back head, side rods, springs, etc. This action may be emphasized by operating a hammer drill under exaggerated conditions, with the cutting end of the drill bit made blunt, upon an impenetrable hardened steel block.

The manner in which the cutting edge is applied to the work in the bottom of the drill hole is equally an important factor in determining speed as the length of the cutting edge, and it also governs to a great extent the life of the cutting edge. When drilling a round hole in rock, the work that the bit has to do is to separate the rock particles from the mass not only as applied to the bottom of the drill hole, but also from the side walls. This imposes a heavy duty upon the extremities of the cutting and reaming edges of the bit, and the amount of work that the cutting edge must do increases, not in proportion to the diameter of the hole, but in proportion to the square of its diameter. As an illustration, when drilling a 1-in. diameter hole, we remove 0.7854 cu.in. of rock per lineal inch of advance, but when drilling a hole 2 in. in diameter, we remove four times this amount, or 3.1416 cu.in. of rock per lineal inch of advance, and in the case of a 3-in. diameter hole we remove nine times as much rock as we do in a hole 1-in. in diameter. This accounts for the unequal wear that takes place along the cutting edge of a radial cutting-edge bit, which, if uniformly tempered, will result in a gradually increasing flattened edge radiating from the center. Furthermore, the extreme outer ends of the cutting edge have imposed upon them the additional duty of dislodging the rock particles from the side wall of the drill hole, which, if the bit is not equipped with an ample reaming edge or surface, results in the outer edge of the bit being rounded, thus reducing the diameter of the hole being drilled and decreasing the speed of penetration, with the natural effect of increasing the rebound of the steel from the work. It has been determined by experiment that this condition may be improved in two ways—first, by so shaping the cutting edge that the work is approximately evenly distributed throughout its length and, second, by equipping the extremities of the cutting edge with suitable reaming edges or surfaces which determine the wearing qualities of the gage.

The Angle of Cutting Edge

The angle of the cutting edge should be great enough to withstand the shock to which it is subjected in service without danger of breakage, but it should not provide for more than a reasonable factor of safety, as the greater the angle the less will be the cushioning effect due to penetration and the greater will be the rebound from the work, which, if carried to the extreme, will result in disaster to the drill and its steel. For soft ground a more acute angle than 90 deg. generally works to better advantage than a greater angle, but for the harder ground the requirements are reversed.

The diameter of the reaming edge, or surface, must be greater than the diameter of any other part of the bit in order to permit of free action in the hole.

In Fig. 2 is illustrated the manner in which a bit may be developed by projection to determine the appearance of the different views, and this method of procedure is recommended as the preliminary step of development. The lines *A-A* represent the cutting edge, and the lines *B-A-C* the reaming edges. In all cases the diameter of the extremities of the cutting edges *A-A* should equal the diameter of the reaming edges, as shown in the end view, which necessitates the reaming edges being formed in an arc of a circle the diameter of which is equal to the extremities of the cutting edges. The necessary clearance is provided for the bit by tapering the wings or body portion back toward the drill-steel bar, and if the wings are flattened at their outer, or opposing edges to secure clearance for the reaming edges, care must be taken during the flattening operation to see that the shape of the reaming edges is not distorted.

A good way to determine if the finished bit possesses the required shape of reaming edges and clearance is to employ a ring gage of the same bore as the gage diameter of the bit. This, when passed over the bit and held in axial alignment thereto, should engage by line contact the reaming edges throughout their length, from which the bit is tapered rearwardly to provide clearance.

In the preceding paragraphs reference has been made to the reaming edge. For certain kinds of rocks a reaming edge is desirable only to insure the required clearance for the bit, especially if the formation is tough, close-grained and not excessively abrasive; but in abrasive rock that is easily fractured, a reaming surface curved concentric with the axis of the bit and varying in area dependent upon the conditions is often employed to good advantage.

Shape of the Cutting Edge

It is not a difficult matter to secure proper sizing and shaping of rock-drill bits when a machine sharpener is employed, but it is desirable that the gaging of the bit be performed in independent sizing grooves, supplementary to the main forming grooves in the swaging dies of the sharpener. The reason for this is that the curved surface of the reaming edge for any fixed angle of cutting edge and width of wing varies in its degree of curvature with the diameter of the bit, necessitating a tapered sizing groove in the dies of the drill sharpener, varying in its shape to correspond with the variation in the curve, as illustrated by Fig. 2. When this sizing groove is available, the correct shape of reaming edge or surface for the various gages required in a set of drill steel may be secured by employing a movable stop piece in the dies of the drill sharpener to properly position the steel being worked upon. It is good practice first to form the bit in the shape of a cone which provides for the required taper of the wings or body portion, at a slightly larger reaming-edge diameter than that of the finished bit, after which the required gage diameter is secured by swaging down the extremities of the wings or body in the sizing groove.

The taper of the wings or body of the bit is governed by the size of the bit with relation to the drill steel, the character of the ground and the force of blow. In hammer-drill practice it is not so essential that a long tapered wing be employed as was the case with the reciprocating type of rock drill, but preferably a wing taper of 14 deg. modified adjacent to the cutting end to conform with the curvature of the reaming edges will meet the requirements of the average conditions of ground satisfactorily.

The sizes of clearance grooves are largely dependent on the type of bit used and the character of the ground. They should be large enough to permit free egress of the cuttings.

Dead corners in the cutting edge of the bit are undesirable and should be avoided whenever possible. The practice of making bits with concave or convex cutting edges is largely a matter of opinion based on the conditions encountered. A convex, or raised center, bit is oftentimes desirable in starting drill holes, especially with stoping drills equipped with a pneumatic feed, while concave bits will assist materially in maintaining the alignment of the drill hole. However, tests that have been conducted show no advantage as regards stamina or drilling speed when compared with flat-ended bits identical in all other respects.

Length and Area of Reaming Edges

It has been determined by experiment that the chisel, or single cutting-edge, type of bit is a very fast driller, but when made rectangular in section, the reaming edges are very susceptible to wear. This applies to any bit employing an angular reaming edge with respect to the circumference of the drill hole. The reason for the general adoption of a cross- or an X-bit in preference to a chisel is because they are less susceptible to rifling the drill hole owing to the greater reaming surface provided by the extremities of the four wings, and consequently they may be used for drilling through a greater distance before wear of the reaming edge makes necessary the use of the following length of steel with a reduction in the size of the gage. This is illustrated by Figs. 3 and 4.

The bull bit, Fig. 5, corresponding in many respects to the so-called Joplin bull bit, which for a great many years has been considered the standard type of drill bit for the Joplin-Missouri zinc district on account of its blunt-angled single cutting edge, possesses a greater crushing than wedging action, which is advantageous in a hard, brittle ground, as it results in a shattering action to the rock, which, if it is of such a nature that this action can be taken advantage of, will secure rapid penetration. Instead of the reaming surface being angular in section, it is made concentric with the axis, which has the effect of preserving the gage by virtue of the bearing surface. While a bit of this type was and is desirable for Joplin conditions to enable the ground to be drilled economically owing to the abrasive qualities of the cherty flint rock that prevails throughout the district, there is no good reason why the predominating feature of the Joplin bit should not be taken advantage of in other formations, thus causing the drill bit to cut to a greater depth, or by reducing the variation in gage of the following steel without affecting the linear depth of hole that is drilled before a change in the size of bit is made necessary by wear. It is not, however, recommended for drilling in ground the rock particles of which cannot be readily shattered or disintegrated. Because of the chunky shape of the bit, it lends itself readily to uniform tempering at both the cutting and reaming edges.

A composite bit made by incorporating the advantages of the single cutting-edge chisel bit as shown by Fig. 3 in combination with the predominating feature of the bull bit, Fig. 5, may have the appearance of the Z-bit shown by Fig. 6, which possesses in addition advantages that are not inherent in the other types to which we have referred.

The arc-shaped cutting edges, which are made as terminals of the diagonal, provide for ample reaming surface, besides determining the gage of the bit; and in action they serve to cut a channel around the periphery of the drill hole, which reduces the work of the diagonal by rendering the rock within the circular channel easily broken. Theoretically, this type of bit combines many of the advantages of the other bits described, but owing to its shape difficulty is liable to be experienced in tempering the cutting edge uniformly, and as a result the arc-shaped terminals of the cutting edge are very likely to be made harder than the diagonal, which, on acount of the burden imposed upon them in practice, results in chipping.

The rose bit as shown by Fig. 7 and the cross-bit as shown by Fig. 8 illustrate common and well-known types of radial-cutting-edge bits, and the foregoing statements apply equally well to either type, although the cross-bit has a shorter cutting edge than the former, and for this reason it lends itself to better advantage as applied to hard rock than a radial bit possessing a greater length of cutting edge. If incorrectly formed as regards its reaming edge or surface, it has a tendency to drill a rifled hole, which is not possible with a bit of the rose type having a greater number of cutting edges with corresponding supporting wings.

The Double Cross-Bit

In Fig. 9 is illustrated the double cross-bit which possesses a desirable advantage over those previously mentioned. As shown in the figure, the cutting edges of this bit are not positioned radially with respect to the axis of the bit, but are offset in such a manner that, as the bit revolves in the drill hole, the depressions made by the cutting edges intersect and cross each other in such a way that the work is more evenly distributed over the entire length of the cutting edge and the rock is thus broken diagonally as well as radially. When sharp, the long cutting edge of this bit, in conjunction with its intersection of the cutting depressions in the work, provides for very high drilling speed in a variety of rocks, but in hard ground the cutting edge, when dulled, is very likely to result disastrously to the steel and drill parts. A bit of this type possesses reaming qualities superior to that of the cross on account of the better distribution of the work over the cutting edge, which relieves the extremities from a greater part of the load that they would otherwise carry in disengaging the rock particles from the wall of the drill hole. It will drill a round hole, equal in this respect to the rose bit, but it is not an easy bit to make, owing to the difficulty experienced in causing the metal to flow when being forged to the extremes of the cutting edge.

Difficulty is likely to be experienced in securing a uniform temper for the cutting edges of the cross and the double-cross bits, owing to the size of the clearance grooves adjacent to the extremities of the cutting edge, which pro-

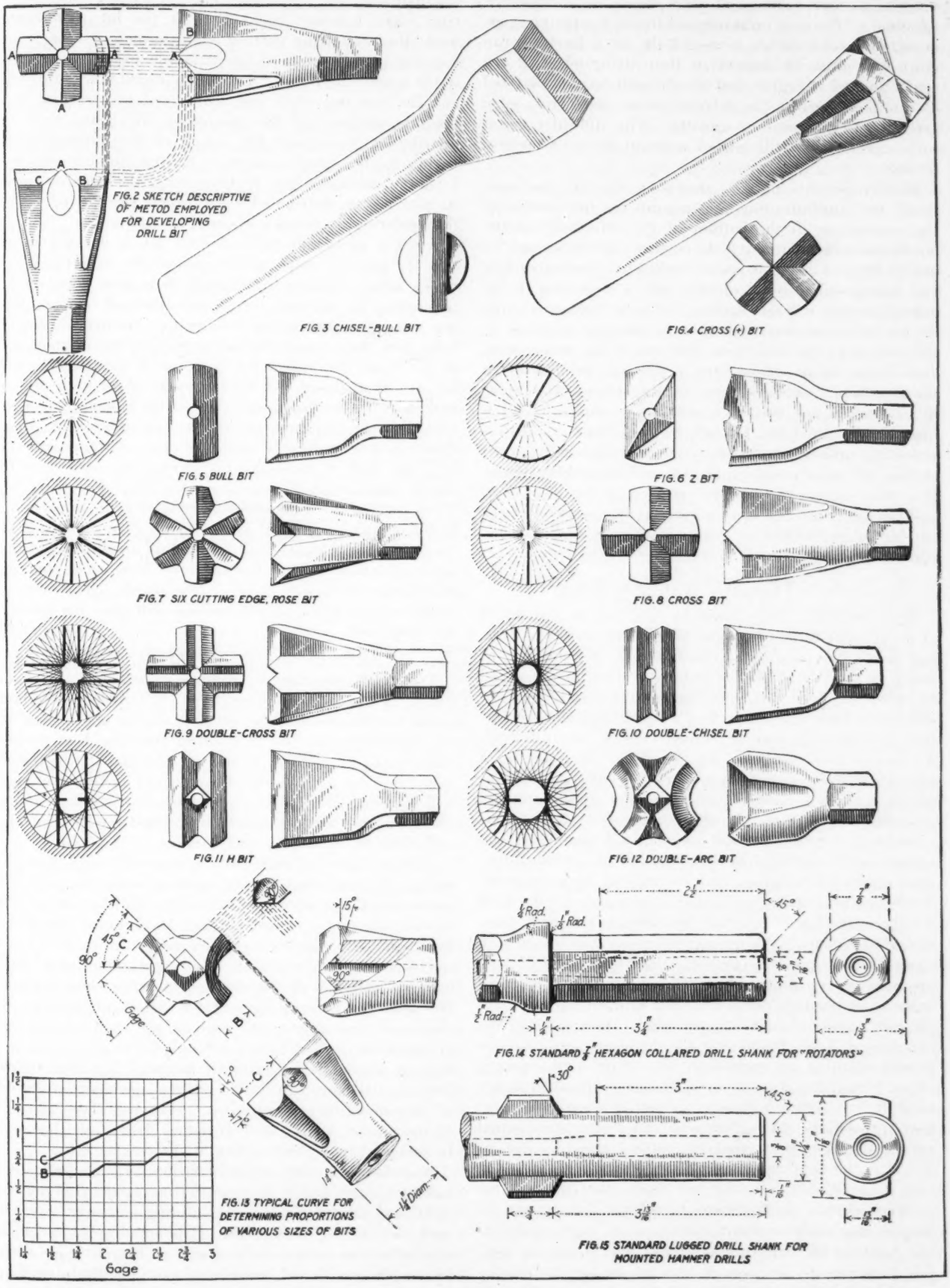


FIG. 2 SKETCH DESCRIPTIVE OF METOD EMPLOYED FOR DEVELOPING DRILL BIT
FIG. 3 CHISEL-BULL BIT
FIG. 4 CROSS (+) BIT
FIG. 5 BULL BIT
FIG. 6 Z BIT
FIG. 7 SIX CUTTING EDGE, ROSE BIT
FIG. 8 CROSS BIT
FIG. 9 DOUBLE-CROSS BIT
FIG. 10 DOUBLE-CHISEL BIT
FIG. 11 H BIT
FIG. 12 DOUBLE-ARC BIT
FIG. 13 TYPICAL CURVE FOR DETERMINING PROPORTIONS OF VARIOUS SIZES OF BITS
Gage
FIG. 14 STANDARD 7/8" HEXAGON COLLARED DRILL SHANK FOR "ROTATORS"
FIG. 15 STANDARD LUGGED DRILL SHANK FOR MOUNTED HAMMER DRILLS

TYPES OF BITS AND SHANKS, WITH TYPICAL CURVE DIAGRAM FOR DETERMINING PROPORTIONS OF VARIOUS SIZE BITS

vide for a greater surface of conductivity for the quenching fluid. If care is not exercised in the tempering operation, the heat from the center of the bit is likely to run down and draw the temper of the cutting edges at the center to such a degree that the bit will become battered at this point, before the extremities of the cutting edge are worn a corresponding amount. This difficulty is not so pronounced in drill bits of more uniform or massive section.

The double chisel bit, as shown by Fig. 10, has practically the same advantages, as regards the intersection of the depressions in the bottom of the drill hole, as the double-cross, and although its cutting edge is shorter by nearly 50%, it does not possess sufficient reaming surface and consequently wears rapidly with a reduction in the gage diameter. When drilling in rock formations that do not crush readily, the cone center that projects in the bottom of the drill hole will retard the penetration, and if the axial hole of the drill steel terminates in the depression midway of the cutting edges, it is liable to become plugged with rock particles or sludge. This is overcome in the H-bit, Fig. 11, by the addition of the intersecting transverse cutting edge, but although a fast cutting bit for a great variety of conditions when sharp, this bit is subject to the same criticism as its forerunner, and besides it has two dead corners at the junction of the cutting edges, which are not conducive to rapid penetration.

New Type of Double-Arc Bit

The double-arc bit, shown by Fig. 12, is the result of an attempt to develop a bit that would meet the average conditions of ground encountered, by retaining as many as possible of the advantageous features possessed by other standard bits, one that would readily lend itself to machine sharpening and, in addition, one the cutting edge of which may be tempered easily and uniformly. To insure this result, it was necessary to resort to a great deal of experimenting under a variety of conditions of ground, force and frequency of blow and speed and strength of rotation. In the comparative experiments conducted, the various drill bits were all hammered and subsequently machined to correct shape of corresponding size, micrometers being used in making measurements. All bits were tempered uniformly, a pyrometer being used for the heating bath, and all drill steels were made from the same material. All comparative tests were made with steels of corresponding weight, length and gage of bits, operated upon under identical conditions. The drill holes were carefully calipered every 6 in. of advance, and the condition of the bits was recorded. As a result of the experiment it was found that the double-arc bit possesses greater stamina as applied to its cutting and reaming edges, permitting it to be used through a greater distance of drill hole before a change of steel is made necessary; that it possesses cutting capacity when sharpened equal to any of the others; that its cutting speed is not reduced as the depth of the drill hole advances to so great an extent as with bits of other types; that wear of the cutting edge is approximately uniform throughout its length, that only a slight reduction in gage results as the depth of the hole increases; and that it may be tempered uniformly throughout the length of the cutting edge. As shown by the diagrammatic drawing, Fig. 12, which illustrates the action of the bit in the bottom of the drill hole, the depressions made by the arc-shaped cutting edges intersect each other as the bit is rotated, while the connecting cutting edge prevents a cone from forming in the bottom of the drill hole, exactly as it does in the case of the H-bit. A perfectly round hole is drilled, and the reaming edges are maintained by virtue of the reaming surface and the manner in which the work is distributed throughout the length of the cutting edge. Owing to the chunky nature of the bit immediately behind the cutting edges, in tempering, the heat retained in the mass is distributed evenly upon the cutting edge, thus securing uniformity where it is required.

After a particular type of drill bit is decided upon and its general shape is determined by experimenting under actual working conditions, it is good practice to proportion the various sizes of bits required for completing a drill hole by making a reference drawing and establishing curves between the minimum and maximum sizes, in which all dimensions for any size or gage of bit may be seen at a glance. A typical curve sheet with sketch applicable to the double-arc type of bit is shown by Fig. 13. For the requirements of this country these curve drawings are preferably made on cross-section paper $\frac{1}{16} \times \frac{1}{16}$ in., and if necessary the curves may be made to double scale as has been done in Fig. 13. For example: To determine the dimensions of a bit of $1\frac{3}{4}$-in. gage, refer to the ordinate indicated by the $1\frac{3}{4}$-in. gage dimension at the bottom of the plate and follow this up through to the point of intersection of the various curves corresponding to reference letters to those on the sketch. The vertical height at the point of intersection will give the dimension required.

Importance of Quality of Steel

Too much importance cannot be attached to the problem of determining the quality of drill steel that is best suited for the ground. The best drill steel is not necessarily the highest-priced, nor is a cheap steel the best for all conditions. In general, it may be said that the best steel to employ for a fixed set of conditions is the steel that will withstand the duty imposed upon it without undue breakage and will withstand the abrasive action of the rock with the least amount of wear.

Hollow drill steel, which is now generally used throughout the United States in combination with hammer rock drills embodying an air or water jet for the purpose of ejecting the sludge or rock cuttings from the bottom of the drill hole, is a comparatively new departure in steel making, and the manufacturers have experienced some difficulty in meeting the requirements, owing chiefly to the fact that the hole throughout the length of the bar introduces (especially in the high-carbon steel) difficulties of manufacture that have not been easy to overcome; and for this reason it is a generally accepted fact that hollow drill steel is more susceptible to breakage than solid steel of corresponding sectional area. However, there are now on the market many excellent hollow drill steels that may be procured in a great variety of shapes and sizes.

The chemical composition of drill steel is a matter that has been subjected to a great deal of experiment by the drill-steel manufacturers, the mining industry and the manufacturers of rock drills. It is an accepted fact that steel of a low carbon content will withstand more abuse by the blacksmith and lends itself more readily to welding than steel embodying a greater percentage of carbon; on the other hand, it has been determined by experience

covering a great many years that the higher-carbon steel will withstand the vibratory shocks to which it is subjected in hammer-drill service, and furthermore, the cutting bit, although requiring more care in the working and tempering, may be made to last much longer than is possible with the lower-carbon steel.

The following specifications for straight carbon hollow drill steel to meet average conditions of ground and air pressure conform with present-day practice:

CHEMICAL COMPOSITION

	Per Cent.
Carbon	0.85 to 0.90
Manganese	0.30 to 0.40
Phosphorus	Under 0.03
Sulphur	Under 0.03
Silicon	0.10 to 0.20

The forging heat of this steel should not be higher than 1600° F. The quenching heat should be approximately 1300° F. (critical or decalescence point). To secure this result the hardening furnace should be set to secure a heat of from 1420° F. to 1440° F.

The following specifications for drill steel as applied to workmanship of the bar stock are fair and reasonable to both the steel user and to the manufacturer:

Bars shall be free from injurious defects, shall have a workmanlike finish, and shall not be defaced by stamping, melt numbers or symbols except within 4 in. of one end of bar.

The outside diameter of bars must not exceed the ordinary commercial limit of stock of this nature and must not be more than $^1/_{64}$ in. under or over the specified size. The hole throughout the length of the bar must come within the following limits:

Size of Drill Steel, In.	Size of Hole — Minimum Diameter, In.	Size of Hole — Maximum Diameter, In.
⅞	¾	⅞
1	15/16	1 1/16
1¼	1 3/16	1 5/16

The hole must be of such size and shape that a steel ball of the size specified by the minimum limit may be passed throughout the entire length. It must not exceed in area that of the maximum limit, and in the case of the hole being elliptical the long diameter must not exceed the diameter of the maximum limit plus $^1/_{16}$ in. The hole must not be more than $^3/_{32}$ in. off center from the axis of the bar, and sharp corners in the hole, seams, flaws or cracks in the bar will be sufficient cause for rejection.

The Drill-Steel Sharpening Shop

No man on the job deserves more consideration than the drill-steel blacksmith, for upon him depends in a great measure the entire success of drilling. A few minutes' carelessness by a blacksmith may undo many days' work of a careful steelmaker. Underheat in hardening naturally results in a soft drill steel, while uneven heating or heating for too short a time will result in a soft-center bit with danger of breakage when the steel is put into service. Present-day practice is sounding the death knell to the old-style coal or coke forge for heating rock-drill steel for forging and tempering, and it is being rapidly supplanted with the gas or oil furnace, which has a great many points in its favor, chief among them the fact that it may be adjusted to approximately maintain the proper temperature in the heating chamber and thus obviate overheated or burnt drill steel.

A word of caution should be introduced against the common practice of allowing the bits to remain in the furnace longer than is necessary to bring the heat up slowly and uniformly to the desired temperature, which in practice is commonly termed "soaking." This has a tendency to open the grain of the metal by enlarging the crystals and produces brittleness. The blacksmith should handle his steel in rotation by advancing each steel one step nearer the point of withdrawal when a new drill is inserted.

The furnace is preferably constructed with baffle plates or surfaces to insure the maximum heat of the blast being directed against or over the drill bit just prior to the point at which it is withdrawn from the fire. The number of steels that can be heated in the furnace at one time is determined by the time required to bring the heat of the bit up to the proper point and the speed at which it is withdrawn for forging or tempering. It is desirable to both forge and temper drill steel on the rising heat, which necessitates the steel being withdrawn from the furnace the instant the required heat is obtained.

Gas as fuel is recommended where it is accessible and cheap, as it is the cleanest and costs least for installing. If oil is used, it is desirable to have the oil-storage tank below the level of the burner, as the fire risk is lessened. A satisfactory grade of fuel oil may be procured at current prices ranging from three to five cents per gallon.

In isolated districts a great many of the mine blacksmith shops are equipped with home-made furnaces, the burner only being purchased outside. A sketch of such a furnace, which may be made at comparatively slight expense with equipment to be found in the average smith's shop is shown in Fig. 16. If a pyrometer is used for determining and checking the heating furnace, a base-metal outfit is recommended on account of its simplicity and the fact that its upkeep is slight. The pyrometer should be checked periodically. If the base-metal couple is used, one of the fire ends can be kept as a standard and the fire end in daily use compared with this standard. Each month or so a new fire end can be used for the standard and the old standard put in daily use. The indicator or galvanometer should be adjusted daily for the zero reading. If the temperature of the cold junction of the fire end is determined with an ordinary thermometer, the indicator can be adjusted to this temperature.

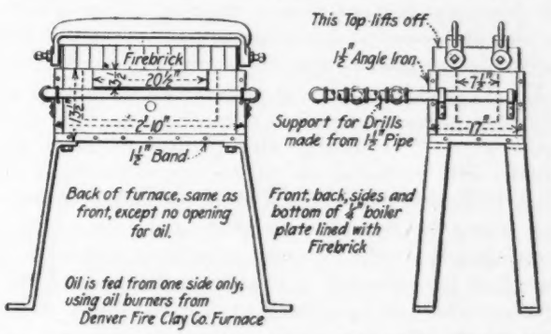

This Top liffs off
Firebrick
20½"
1½" Angle Iron
7½"
2'-10"
Support for Drills made from 1½" Pipe
1½" Band
17"
Back of furnace, same as front, except no opening for oil.
Front, back, sides and bottom of ¼" boiler plate lined with Firebrick
Oil is fed from one side only, using oil burners from Denver Fire Clay Co. Furnace

FIG. 16. OIL-BURNING DRILL-HEATING FURNACE

For drill steel of the carbon content specified, the forging heat should not exceed 1600° F. The forging operation should not be continued after the steel fades from a good red color, as working a steel cold (below its critical range) distorts the refined structure and tends to produce brittleness. It is better to reheat the steel to finish the forging operation than to chance a bit or shank breaking underground.

Too much emphasis cannot be placed upon the desirability of forging the bit and shank end of the drill steel by subjecting it to percussive action instead of squeezing the part into shape on the principle of the bulldozer. Drill-making machines are now on the market utilizing the hammer blow for both upsetting and swaging. This method approaches more closely the results secured

from hand-sharpening, which blacksmiths know is advantageous to the standing-up qualities of the bit. It furthermore permits the forging operation to be done at a comparatively low heat, as the conductivity of a rapidly reciprocating swage hammer has been found to be considerably less than that of a squeezing die.

For all hollow drill shanks equipped with a collar or lugs, the length from the shoulder to the striking end should not be more than $\frac{1}{16}$ in. over or under the specified size, and all transverse dimensions should not vary more than $\frac{1}{64}$ in. in either direction from the size specified (see Figs. 14 and 15). The striking end should be kept square and smooth, with both the inner and outer edges slightly rounded. The hole in the shank for the reception of the water tube should invariably be kept central and open to the size specified, for a distance of from 3 to 3½ in. from the tip. This hole in the smaller sizes of hollow drill steel should not be less than $\frac{5}{16}$ in. and in the larger sizes, $\frac{3}{8}$ in.; otherwise a great deal of trouble will be experienced by broken water tubes.

Device for Keeping Holes in Shank and Bit Open

For large installations it is recommended that a pneumatic punch be provided for punching out the hole in both the shank and bit end during the forging operation. A number of successful devices have been developed for the purpose. A sketch of such a pneumatic punch is shown in Fig. 17, which, in general principle of design and operation, has been adopted by a number of the mining companies in the Southwest. Briefly, it consists of an air cylinder with its piston and piston rod, to the front end of which is detachably secured a taper punch of the required size. Compressed air is admitted to the front and rear piston chambers by a four-way plug valve under the hand control of the operator. Directly at the rear of the air cylinder is a cushion cylinder with its piston attached to the extension piston rod of the air cylinder. This cylinder is filled with oil, which is displaced from one end to the other through a small bypass connection. Forward of the air cylinder is a clamping device with suitable gripping jaws for the drill steel. This may be made hand-operative or equipped with an air cylinder and piston connected by a toggle with jaws, which assists materially in minimizing the manual operation. With an apparatus of this kind steel may be punched satisfactorily while hot, in from four to five seconds.

Pyrometers and Compasses to Determine Proper Heat for Tempering

Whatever the grade of carbon drill steel adopted, it is essential that the critical or decalescence point be determined to assist the smith in securing and maintaining the proper heat at which the material may be hardened and tempered to the best advantage. It is called the critical point because it is the point in the temperature of the piece being heated at which a change takes place in the structure of the steel due to the carbon being dissolved. It is the point below which steel will not harden when quenched, and by coincidence it is the point at which the steel loses its magnetism. For the purpose of illustration, take a bar of drill steel about 10 in. long and nick it in six or eight places spaced equi-distant, to make breaking easier. Put one end in the furnace and heat it to nearly a white heat, letting the heat gradually run out to a dull red at the opposite end of the test piece and then quench it in cold water. Now break the piece at each nicked place, and it will be found that the fracture that is closest and finest grained was nearest to or at the critical point. A skilled smith may thus determine this point by experiment and gage the heat by taking note of the color, but this method is unreliable unless a check is provided, for oftentime the eye gets "off color," being influenced by the degree of surrounding light and the physical condition of the operator. It may be determined by means of the pyrometer, because when the steel reaches the critical point, it absorbs an abnormally large amount of heat. For instance, if we were to insert a pyrometer into a piece of steel being heated in a furnace, the temperature would be found to rise at a uniform rate until the critical point is reached, when its rising temperature is suddenly halted by the physical and chemical changes that take place in the steel, which cause it to absorb a certain amount of heat energy. In cooling, this condition is just reversed and a piece of steel cooled through the critical point will be found to give out a considerable quantity of heat. While the pyrometer method is reliable, the following, which may be adopted as a check, is perhaps more practical for the average mine smith:

A small pocket compass, preferably with a jeweled needle and stop, which may be procured in almost any

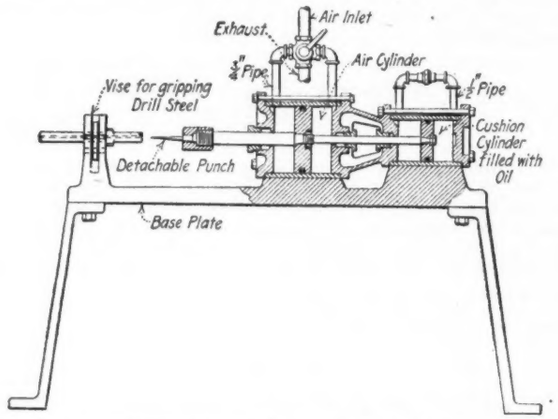


FIG. 17. PUNCH FOR HOLLOW DRILL-STEEL BITS AND SHANKS

jewelry or hardware store at nominal cost, and a pair of brass or other nonmagnetic tongs are the only essentials. This compass should be set upon a wooden stool in close proximity to the forge and in such a position that the natural swing of the test piece back and forth, when testing, will be in a plane at right angles to the needle. In other words, the test piece being hardened should be swung, using the brass tongs, east and west. By passing the test piece forward and backward close to the compass, the magnetism of the metal will cause the needle to be deflected first one way then the other and will continue to deflect the needle until the proper heat for quenching has been obtained. The right heat is reached when the material loses its magnetism. It does not follow, if the needle remains stationary the first time you test, that the heat is right, because after the material has reached a certain degree of heat the magnetism leaves the steel, so there is no influence on the needle and it may be too hot. Different grades of drill steel having different carbon content require different degrees of heat. The magnetism leaves the steel at that degree of heat corresponding to the carbon content in the steel, and in every

case this is the proper heat for dipping. After testing, the drill bit may, by remembering the color, be given a corresponding heat, quenched in the bath to harden it and tempered by subsequently subjecting the cutting end to the proper heat by drawing the temper required to give the bit the necessary toughness for the work.

For tempering the finished bit, it should be heated slowly and uniformly until the critical point is reached and then quenched in the bath, in which provision may be made for automatically drawing the temper.

While the critical point in the heating of carbon steel does at all times indicate the degree of heat at which the steel may be quenched to the best advantage, it must be borne in mind that there will be a rapid drop in temperature of the heated steel during the time period required to transfer it from the heating furnace to the quenching bath; and in order to insure the steel being quenched at the critical point, it should be heated to approximately 100° F. higher before being removed from the furnace.

As the striking end of hollow drill steel for hammer drills is usually equipped with lugs or a collar to properly position the steel in the path of the piston hammer, it is desirable to subject the shank end, for a distance of from 2 to 2½ in. below the lugs or collar, to an oil-treatment in order to provide for toughness and to make the angular section through which the rotary motion of the drill chuck is transmitted to the drill steel as wear-resisting as possible. To accomplish this, heat the shank slightly above the critical point, remove from the furnace and dip the tip end in a receptacle containing several pounds of cyanide of potassium, then plunge in oil, letting it remain in the oil until cold.

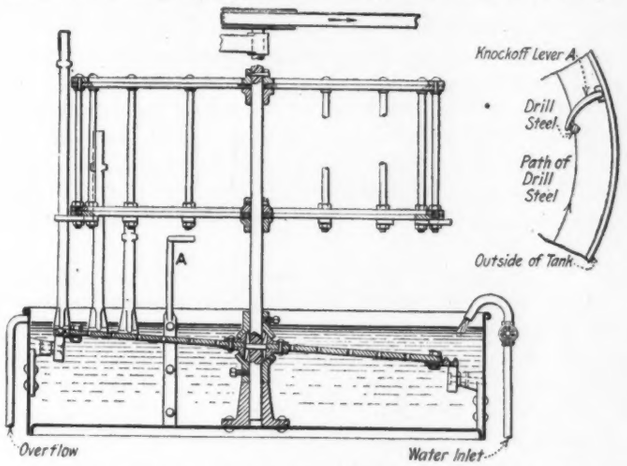


FIG. 18. THE HOMESTAKE QUENCHING TANK FOR DRILL STEEL

For holding the oil a quenching tank will be required equipped with a grate bottom placed two or three inches above the bottom of the tank. This will prevent the steel from coming in contact with dirt or sediment in the bottom and will serve to eliminate "soft-spot" trouble. A great many devices for quenching and drawing the temper of rock-drill bits automatically have been and are being used successfully, but a device similar to that adopted by the Homestake Gold Mining Co. is worthy of consideration for average mine and contract conditions. Fig. 18 shows a diagrammatic sketch of this apparatus.

This consists of a metal tank partly filled with running water in which is submerged a revolvable perforated disk set at an angle with respect to the surface of the water. From this disk a skeleton framework is provided for supporting and nonpositively locking the drill steel in position, which is disengaged by a stationary knock-off lever when the steel has been tempered for service. For hardening and tempering the drill bit, the steel is removed from the heating furnace when the critical point has been reached and the bit end is immediately quenched by placing it in a vertical position on the outer edge of the revolving disk and at the point which is nearest the surface of the water, it being locked in this position by a spring latch. This disk is made to revolve slowly and continuously, thus causing the drill bit to be submerged gradually in the bath (which is in a state of agitation) until it reaches the point diametrically opposite that at which it was positioned. Then it is gradually raised from the bath until it is automatically disengaged by the knock-off lever, it having traveled through approximately 315 deg. of a circular path. A number of drill steels may be mounted on the disk, depending upon the number of vertical supports with which it is provided.

This method of quenching and tempering automatically possesses many advantages, chief among which is that it insures uniformity. The apparatus is flexible, and the maximum and minimum depth of submersion and the speed at which the disk revolves may be varied to suit the requirement. Owing to the gradual submersion of the bit, there is a blending from the hard to the untempered portion, which reduces to a minimum the liability of breakage.

Inspection of Drills Before Leaving Shop

It is excellent practice to inspect each drill steel subsequent to the tempering operation and prior to the transportation of the steel from the shop to the drills. It should be the duty of the inspector to see to it that each piece of drill comes within the permissible limits that may be established. He should make sure—

That the drill steel is straight and that the bit and shank are formed in alignment with the steel body;

That the shank is of the proper length and shape;

That the lugs or collar at the base of the shank are of the proper diameter and length;

That the hole throughout the steel is of the proper size and free from obstruction;

That the striking end of the shank is flat and square, with the inner and outer edges slightly rounded;

That the bit is of the proper shape, with the cutting and reaming edges formed full and to the required size;

That the gage of the bit is of the correct size for the length of the steel;

That the reaming edges of the bit are concentric with the axis of the steel;

That the angle of the reaming side corresponds to the standard that may be establish for the existing conditions;

That there are no sharp corners at the shoulder where the bit blends into the steel body;

That the drill steel is free from cracks and other imperfections that might result in breakage when put into service;

That the steels are of the proper length to correspond with the established length of steel change.

The object of the smithshop foreman should not be to see how many drill steels he can put through the forge or drill-sharpening machine, but to see how many correctly shaped, gaged, tempered and sorted drill steels he can turn out per unit of time.

For inspecting the shanks, a hollow gage of the correct length with its inside diameter of such a size and shape that it may be readily passed over the shank body and lug is recommended.

For inspecting, a limit ring gage about 1½ in. long for each size of bit may be used to advantage. The bore of the gage should be slightly tapered in order that the larger diameter at one end may determine the maximum, and the smaller diameter of the other end the minimum permissible for each size of bit. The method employed when inspecting is to place the large end of the gage over the finished bit, which, if it enters but does not go through, will indicate that the gage diameter of the bit is within the permissible limits. It will also determine if the reaming edges are correctly formed. For convenience the ring gage may be made with a segment of its wall cut away, thus providing a means for the inspector to determine if the required clearance is provided at the rear of the reaming edge.

Remember that great importance is attached to having the drill bit true in every particular so that the shank is in a straight line with the axis of the steel and the outside edges of the bit are in a true circle.

The Judge Zinc Plant

The annual report of the Judge Mining and Smelting Co., operating at Park City, Utah, gives an interesting brief description of the process used at the Judge zinc-reduction plant, by C. A. Hansen, the designer and builder.

The plant operates on concentrates, which are received in the storage bins. From the receiving bins the concentrates are elevated to the top of the roaster building and descending, pass through a standard Wedge zinc furnace. The roasted product is then elevated to the bins that feed the leaching plant. Leaching is accomplished by agitating the roasted concentrates with an 8% sulphuric-acid solution in Deveraux tanks.

The leaching tank product is discharged to classifiers, which remove the coarser insoluble material, the latter being collected in storage bins. From the classifiers the solution and fine slimes are discharged to a Dorr thickener, the slimes being settled and discharged to an Oliver filter and the overflowing solution passing on to the purification apparatus.

The slimes, collected on the Oliver filter, are stored with the material discharged from the classifiers. These materials carry the lead and silver and are disposed of by sale to the lead smelters.

In leaching the roasted concentrates, copper, cadmium and other impurities are dissolved as well as the zinc. It is impossible to recover the zinc from the solutions until these impurities are removed, and this essential operation is accomplished by passing the solution through tube mills filled with zinc shot, the copper, etc., being thrown out as sponge metal, which is collected on filter leaves. The filtered solution is collected in large tanks which feed the electrolytic cells.

In the cellroom there are 120 cells at present installed, with room provided for an additional 16. These are at present arranged in two groups of 60 each, and each group is energized by means of its own 5000-ampere 250-volt generator. Each cell carries 12 aluminum disks, 5 ft. in diameter, mounted on a shaft so arranged that it can be rotated slowly. Alternating with the aluminum cathode disks are 13 lead anodes, which are supported independently of the shaft.

Current, passing from the lead anodes to the aluminum cathodes, carries the zinc with it and is deposited upon the rotating disks. In the course of about three weeks each shaft carrying 12 disks collects about 5000 lb. of zinc. The loaded shaft is removed, the zinc stripped, and the shaft is reassembled and returned to the cell. The stripped zinc is melted down and cast into cakes and is then ready for the market.

As the zinc is removed in the cellroom, the sulphuric acid with which it was combined in the leaching plant is set free and becomes available for leaching another batch of roasted concentrates.

The roaster was started on Feb. 1, the leaching plant on Feb. 10 and the cellroom on Feb. 25, 1916. At present writing, one-fourth of the cellroom is operating, turning out about three tons of zinc per day. As rapidly as construction permits, aditional cells are being connected.

All of the more important apparatus has been operated and has been found suited to the work for which it was intended. Minor changes have, naturally, been indicated, and these changes are being made as rapidly as possible. No serious difficulties have been encountered, nor are they expected to crop out in the future. Exterior and interior views of the plant are shown in the accompanying full-page illustration.

The average of the ore handled by the company during 1916 was 4164 tons of crude averaging 30.05 oz. Ag, 0.026 oz. Au, 19.34% Pb, 1.26% Cu, 9.69% Zn and 6.75% Fe. From this there was made 10,019 tons of lead concentrates averaging 28.93 oz. Ag, 0.037 oz. Au, 31.33% Pb, 1.18% Cu, 8.85% Zn and 19.45% Fe, and in addition, 2929 tons of zinc concentrates averaging 21.47 oz. Ag, 0.19 oz. Au, 4.38% Pb, 44.58% Zn and 6.54% Fe. The output of metal for the year was 447,852 oz. Ag, 535.16 oz. Au, 8,114,627 lb. Pb, 5,153,049 lb. Zn and 341,198 lb. Cu.

Waste Dilution at Ray

According to the annual report of the Ray Consolidated Copper Co. for 1916, no accurate figures regarding the extent of waste admixture or so-called waste dilution that accompanies the mining of an orebody by the method practiced at the property, have yet been obtained. A certain series of sections have, however, been completed or nearly completed; the average grade of the tonnage of these blocks, amounting to approximately 8,500,000 tons, was 1.89%.

If, however, the average grade of all ore produced to date is used as an approximation, a shrinkage of 0.2% Cu is indicated. This is about 10.5% of the assay value as indicated by development records and is a lower factor than should be expected in the application of the mining system employed, and more particularly so in its application to the upper zones of orebodies, where the dividing planes between ore and capping are not only very indefinite as to position, but irregular in contour.

As the upper lines are worked out, it will be a much simpler matter to mine clean ore.

EXTERIOR OF JUDGE ZINC-REDUCTION PLANT AT PARK CITY, UTAH, AND VIEWS IN CELL ROOM, SHOWING REVOLVING ALUMINUM DISK CATHODES

Flotation Litigation at Butte

The suit of the Minerals Separation Co. against the Butte & Superior Mining Co. continues at Butte, Mont. Some time has been taken up with the presentation of testimony by the Butte & Superior, much of the evidence being of different character from that presented in the original Hyde case. Metallurgists and scientists of the Chino, Utah Copper, Ray, Nevada Consolidated, and other companies using the flotation process, as well as the head officers of the Butte & Superior have been on the stand. Experiments were performed in the presence of the court for the purpose of proving that the Everson patents, granted 20 years before those of Minerals Separation Co., were productive of the same results. A special point aimed at was to prove that there is no critical point in the process, but that the varying amount of oil per ton used merely affects in a general way the results obtained.

Prof. F. H. Taggart, of Yale, was one of the leading witnesses. He presented data secured by him on the operation of oil flotation process at the plant of the Utah Copper Co., at Arthur, and gave also a detailed description of the process showing the function of oil in the formation of a stable froth, and its action as an agent in the separation of sulphide from gangue. He also went into the scientific phases of the amount of oil required, and the effect of varying amounts on the result. He said there are three different conditions that affect the amount of oil needed—one being the amount of agitation, another the amount of sulphide material present, and the third the amount of water present. Prof. Frederick E. Beach, of Yale, also presented testimony substantiating that of Dr. Taggart. He gave data on experiments that he had carried on for years. At the conclusion of his testimony he was asked the question: "Do you recognize any difference in the process from a minimum of something less than a pound of oil to the ton of ore, up to conditions of 200 lb. of oil to the ton of ore." In reply he said, "I can see no difference in the physical phenomena, and the principle of the process." Professor Bancroft, of Cornell, spent one day on the stand, and his testimony was confirmatory of that given by the Yale scientists. Minerals Separation argues that these witnesses are not familiar with the actual practice of the flotation process and are not competent to decide upon essential details.

Tungsten Producers Adopt Ore and Concentrate Prices

A schedule of prices, effective May 1, 1917, for scheelite ore or concentrate has been adopted by the leading tungsten producers of the United States as a result of the meeting held Feb. 10, at San Francisco. The meeting was attended by officials representing three Colorado and four California producing companies and two selling agents, as follows: G. S. Wood and Nelson Franklin of the Rare Metals Co., Denver, and W. W. Degge of the Degge-Clarke Co., Boulder, Colo.; Frank W. Griffen, Tungsten Mines Co. of Los Angeles; W. M. Hamaker, Tungstonia Mines, Inc., Los Angeles; A. J. Clarke, Standard Tungsten Co., Los Angeles; E. C. Voorheis, Atolia Mining Co., San Francisco; S. L. Schwartz and W. A. Stewart of the L. H. Butcher Co., selling agents, San Francisco. No organization was effected or undertaken. The purpose of the meeting was merely for the purpose of discussing matters pertinent to the business of selling tungsten produced by the mine owners and included the following topics: Terms of sale, packages, analysis, chemists, basis of sale, importations, duty legislation, equalization of freight rates, developments of uses for tungsten, investigation of resources, regular form contracts, options. Action was taken by the meeting upon terms of sale, basis of sale and of packages; and data were adduced regarding importations, production and freight rates. But no action taken upon other matters discussed.

It was decided that terms of sale should be 90% sight draft against bill of lading; and that packages should be charged for on the basis of 25c. per 100 lb. Quotations were based on 55% concentrate. The schedule prepared by the several companies for their individual use includes a minimum of 40% and a maximum of 70% WO_3 and prices ranging from $14 per unit for the minimum per cent. and $23 per unit for the maximum per cent.; the basic price, $18.50 for 55% and $20 for 60%. The price per ton for ore of minimum per cent. is $560; maximum, $1610. Ore of 55% WO_3 is scheduled at $1017.50 per ton. The producers are not bound by the decision of the meeting as to the schedule of prices which is subject to change without notice, or the terms of sale or packing. But it is expected that the leading producers of the country will maintain generally uniform prices and act in harmony in other matters discussed by the meeting.

It was stated in the meeting that the freight rate from Boulder to Pittsburgh is about 25c. per unit and from California points to Pittsburgh and New York districts about 45c. per unit. Importations of tungsten in the first quarter of 1917, according to a telegram to the meeting from Charles Hardy, of New York, totaled 1185 tons. Of this amount 300 tons was in turn exported. The average importation is about 200 tons per month. The average production in the United States is about 500 tons per month, of which more than ½ is produced in the state of California.

ATOLIA MINING CO. SCHEDULE OF PRICES FOR SCHEELITE ORE OR CONCENTRATES

(Subject to change without notice)
Effective May 1, 1917

Per Cent. WO_3 (Tungstic Acid)	Price per Unit WO_3	Price per Ton of Ore (2,000 lb.)
40	$14.00	$560.00
41	14.30	586.30
42	14.60	613.20
43	14.90	640.70
44	15.20	668.80
45	15.50	697.50
46	15.80	726.80
47	16.10	756.70
48	16.40	787.20
49	16.70	818.30
50	17.00	850.00
51	17.30	882.30
52	17.60	915.20
53	17.90	948.70
54	18.20	982.80
55	18.50	1,017.50
56	18.80	1,052.80
57	19.10	1,088.70
58	19.40	1,125.20
59	19.70	1,162.30
60	20.00	1,200.00
61	20.30	1,238.30
62	20.60	1,277.20
63	20.90	1,316.70
64	21.20	1,356.80
65	21.50	1,397.50
66	21.80	1,438.80
67	22.10	1,480.70
68	22.40	1,523.20
69	22.70	1,566.30
70	23.00	1,610.00

(The above prices are f.o.b. Atolia, Calif.)

Military Books For Engineers

In the *Journal* of Feb. 5, 1916, was published a list of books by authority of the Secretary of War in response to frequent requests from civilian engineers. We are receiving requests for this information, and considering also present conditions, we are republishing the list with some additions. The widespread movement for military training among engineers makes this list especially opportune. For first reading engineers are advised to purchase Nos. 32, 60, 59, 3, 31, 30, 58 and 22 in the order named.

A. MILITARY POLICY, CONDUCT OF WAR AND MILITARY HISTORY

The following abbreviations are used: Supt. of Docs., Superintendent of Documents, Government Printing Office, Washington, D. C. Book Dept., Book Department, Army Service Schools, Fort Leavenworth, Kan.

1. OFFICIAL BULLETIN, Vol. 1, No. 2, Office of the Chief of Staff, Washington, D. C. (Especially pp. 21-39.) Publisher: Army War College, Washington, D. C. Free. (An official outline of the theory under which our forces are to be organized and administered.)

2. MILITARY POLICY OF THE UNITED STATES. Upton. May be obtained from Supt. of Docs.; paper, 50c.; cloth, 65c. (A most valuable and comprehensive review of this subject.)

3. FIELD SERVICE REGULATIONS, 1914. May be obtained from Supt. of Docs.; 60c. (A condensed official statement of principles, methods and details of military operations.)

4. ELEMENTS OF STRATEGY. Fieberger, Publisher: U. S. Military Academy, West Point, N. Y. May be obtained from Book Dept.; 75c. (A short outline, with historical illustrations.)

5. CONDUCT OF WAR. Von der Goltz; translated by J. Dickman, Hudson Publishing Co., Kansas City, Mo. May be obtained from Book Dept.; $1.70. (The standard work on this subject, covering generally the same ground as 4, but more abstractly and elaborately.)

6. ON WAR. Clausewitz; translated by J. J. Graham; 3 vols.; K. Paul, Trench, Trubner & Co., 1908. May be obtained from Book Dept.; $6.60 (including postage and duty). (The greatest classic on the subject; a complete analysis of the phenomenon of war, and profound discussion of the mechanism thereof. Written early in the 19th Century, it is still the foundation of modern military theory.)

6½. THE NATION IN ARMS. Von der Goltz. May be obtained from Book Dept.; $2.50. (An excellent modern work on war; less elaborate but more readable than Clausewitz.)

7. AMERICAN CAMPAIGNS. M. F. Steele; 2 vols. Publishers: Byron S. Adams Publishing Co., Washington, D. C. May be obtained from Book Dept.; $4.50. (In addition to careful historical surveys of all the campaigns from the Colonial Wars to the Spanish American War, these lectures give extensive and valuable comments as to the military principles.)

8. A STUDY OF ATTACKS ON FORTIFIED HARBORS. Rodgers; Proceedings Nos. 111, 112 and 113, United States Naval Institute, Annapolis, Md.

9. LESSONS OF THE WAR WITH SPAIN. Mahan. Publishers: Little, Brown & Co., Boston, Mass. May be obtained from Book Dept.; $2. (Of special importance, as showing the true relation between our coast defense and our navy.)

10. REPORTS OF MILITARY OBSERVERS ON THE RUSSO-JAPANESE WAR. Part III, J. E. Kuhn. May be obtained from Supt. of Docs.; 60c. (In addition to an account of operations, this report contains valuable information as to fortification and siege work, organization and equipment.)

11. ORGANIZATION AND OPERATION OF THE LINES OF COMMUNICATION IN WAR. Furse, 1894. Publishers: Wm. Clowes & Sons, Ltd., London. (An old but comprehensive survey of this subject, with much historical information.)

B. PERMANENT FORTIFICATIONS

(The references given cover chiefly the principles and general features of this subject; the details are mostly printed in unavailable form, either in service journals or in confidential documents. References to some of the former can be furnished, if desired.)

12. REPORT OF NATIONAL COAST DEFENSE. (Taft) Board, 1906. May be obtained from Army War College, Washington, D. C. Free. (The official project for harbor defenses of the United States. On account of progressive obsolescence of seacoast defenses, this project has been, or is being, modified, but still sets forth clearly the fundamentals.)

13. LECTURES ON SEACOAST DEFENSE. Winslow. Publishers: United States Engineer School, Washington Barracks, D. C. Price, 50c. (Much of these lectures relates to technical details, and a considerable part is now obsolete.)

14. PERMANENT FORTIFICATIONS. Fieberger, 1900; United States Military Academy, West Point, N. Y.; $1. May be obtained from Book Dept. (While rather old, this work gives a simple presentation of the fundamentals on its subject, including an historical outline. A revised edition will soon be published.)

15. FORTIFICATIONS. C. S. Clarke. Dutton & Co., New York; $4.50. May be obtained from Book Dept. (A treatise on the same lines as 14.)

16. PRINCIPLES OF LAND DEFENSE. Thuillier, 1902; Longmans, Green & Co. May be obtained from Book Dept.; $3.83. (A valuable work, covering the principles of both field and permanent fortification.)

C. ORGANIZATION, EQUIPMENT AND DUTIES OF ENGINEER TROOPS

17. FIELD SERVICE REGULATIONS, 1914. (See A. 3.)

18. TABLES OF ORGANIZATION, 1914. May be obtained from Supt. of Docs.; 25c. (These tables represent—subject to modification and within the limits of existing law—the approved policy of the War Department with regards to organization.)

19. OFFICIAL BULLETIN, Office of the Chief of Staff, Vol. 1, No. 4 (Appendix 4). Use of Engineer Troops. Publisher: Army War College, Washington, D. C. Free. (An official statement of the principles which should govern in the use of engineers, with practical suggestions.)

20. DUTIES OF ENGINEER TROOPS IN A GENERAL ENGAGEMENT OF A MIXED FORCE. Burgess. Publisher: United States Engineer School, Washington Barracks, D. C.; 25c. (Obsolete in some respects, particularly organization, but excellent in general scope.)

21. GENERAL ORDERS NO. 6, WAR DEPARTMENT, 1915. May be obtained from the Adjutant General, United States Army, Washington, D. C. Free. (Prescribes the training of Engineer troops.)

22. STUDIES IN MINOR TACTICS. Army Service Schools, 1915. May be obtained from Book Dept.; 50c. (The principles of Minor Tactics are set forth by solution of a series of problems.)

23. TECHNIQUE OF MODERN TACTICS. Bond & McDonough, 1914; Banta Publishing Co., Menasha, Wis. May be obtained from Book Dept.; $2.55. (This work covers, in a very specific way, the principles of tactics for all arms, a general knowledge of which is essential for engineers.)

24. OPERATION ORDERS. Von Kiesling; translation. May be obtained from Book Dept.; 50c. (A lucid exposition, by use of assumed cases, of the operation of highly trained troops of all arms in various phases of battle.)

25. ENGINEER UNIT ACCOUNTABILITY MANUAL. May be obtained from Supt. of Docs.; 5c. (Official lists of standard equipment supplied to Engineer batallions and companies.)

26. ORGANIZATION OF THE BRIDGE EQUIPAGE OF THE UNITED STATES ARMY, 1915. (Revised edition just going to press.) (Includes description of equipage and regulations for ponton drill.)

27. OFFICERS' MANUAL. Moss; Banta Publishing Co., Menasha, Wis.; $2.50. May be obtained from Book Dept. (Treats of routine duties of officers, customs of the service, army organization, etc.)

28. MANUAL FOR COURTS MARTIAL. May be obtained from Supt. of Docs.; 50c.

D. FIELD ENGINEERING

(Military field engineering at the front differs from ordinary engineering work in the field, it being generally simpler, of a rough-and-ready character, and especially because of the limited equipment which can be taken along with the advance of an army and because of the necessity of working in strict subordination to the military situation. In rear of the army on the contrary, conditions are very similar to those governing ordinary engineering operations, and civilian organization is suitable, subject to directions by the higher military staff. Little attempt is made in works on military field engineering to treat of general engineering methods.)

29. FIELD FORTIFICATION. Fieberger, 1913; John Wiley & Sons, New York. May be obtained from Book Dept.; $1.90. (In addition to technical details, this work gives valuable historical illustrations of the principles of this subject.)

30. FIELD ENTRENCHMENTS, SPADE WORK FOR RIFLEMEN. John Murray, London. May be obtained from Book Dept.; 40c. (A very uptodate little work, especially on details.)

31. NOTES ON FIELD FORTIFICATION. Army Field Engineer School. May be obtained from Book Dept.; 30c.

32. ENGINEER FIELD MANUAL. Professional Paper No. 29, Corps of Engineers, United States Army; 3d edition, 1909. 500 pages. May be obtained from Supt. of Docs.; $1. (A very complete official pocketbook for engineer officers in the field, containing much tabular and technical data, as well as brief outlines of principles and methods. The subjects covered are, Part I, Reconnaissance; Part II, Bridges; Part III, Roads; Part IV, Railroads; Part V, Field Fortification; and Part VI, Animal Transportation. A new revision of the manual is contemplated, but will not be ready within a year. The portion of the manual relating to field fortification, being somewhat obsolete, should be considered in connection with either 30 or 31 above. The portion relating to railroads is largely superseded by 35 below.

33. NOTES ON BRIDGES AND BRIDGING. Spalding. May be obtained from Book Dept. (A small pamphlet on military bridging.)

34. MILITARY TOPOGRAPHY FOR MOBILE FORCES. Sherrill, 2d edition; Banta Publishing Co., Menasha, Wis., 1911. May be obtained from Book Dept.; $2.25. (Besides matter given in ordinary textbooks on surveying, this work gives in detail the special methods of sketching developed in the army for rapid military mapping.)

35. MILITARY RAILROADS. Connor; Professional Paper No. 32, Corps of Engineers, United States Army. Supt. of Docs.; 50c. (Intended to cover general administration of existing railroads for military purposes and the handling of railroads by military personnel in the advance sections where railroads cannot be operated by their regular civilian organizations, or where new railroads are required in the immediate vicinity of the army. Revised edition soon to appear.)

36. NOTES ON MILITARY EXPLOSIVES. Weaver; J. Wiley & Sons, New York; 1912. May be obtained from Book Dept.; $3.25. (Elementary notes on this subject will be found in the Engineer Field Manual and other references cited. This work is more elaborate.)

E. MISCELLANEOUS

37. REGULATIONS FOR THE ARMY OF THE UNITED STATES. Supt. of Docs.; 50c.

38. THE "VOLUNTEER LAW," approved Apr. 25, 1914; Bulletin No. 17. War Department, 1914. May be obtained from The Adjutant General, United States Army, Washington, D. C. Free.

39. GENERAL ORDERS NO. 54, War Department, 1914. May be obtained from The Adjutant General, United States Army, Washington, D. C. Free. (Covers examination of candidates for commissions as officers of volunteers.)

40. GENERAL ORDERS NO. 50, War Department, 1915. May be obtained from The Adjutant General, United States Army, Washington, D. C. Free. (Amends General Orders 54, 1914, as to examination of candidates for commissions in volunteer engineers.)

41. TREATISE ON MILITARY LAW. Davis; John Wiley & Sons, New York. May be obtained from Book Dept.; $5.30.

42. ELEMENTS OF MILITARY HYGIENE. Ashburne; new edition; Houghton, Mifflin & Co., Boston, 1915. May be obtained from Book Dept.; $1.30.

F. PERIODICALS

43. PROFESSIONAL MEMOIRS. Corps of Engineers, United States Army, and Engineer Department at Large; bimonthly (formerly quarterly); Washington Barracks, D. C., Engineer Press; per year, $3.

44. THE ROYAL ENGINEERS' JOURNAL. Royal Engineers Institute, Chatham, England; monthly; per year, $4. (American agents; E. Steiger & Co., 49 Murray St., New York.)

45. JOURNAL OF THE MILITARY SERVICE INSTITUTION, Governors Island, New York. Bimonthly; published by the Institution; per year, $3.

46. JOURNAL OF THE UNITED STATES ARTILLERY. Bimonthly; Fortress Monroe, Va., Coast Artillery School Press; per year, $2.75, including Index to Current Literature; without Index, $2.50.

47. JOURNAL OF THE UNITED STATES CAVALRY ASSOCIATION. Published by the Association at Fort Leavenworth, Kan.; per year, $2.50.

48. INFANTRY JOURNAL. Bimonthly; published by the United States Infantry Association, Union Trust Building, Washington, D. C.; per year, $3.

49. FIELD ARTILLERY JOURNAL, quarterly; published by the United States Field Artillery Association, 601 Star Building, Washington, D. C.; per year, $3.

In addition to the foregoing list, issued by the War Department, the following books are valuable:

50. MILITIA FIELD MANUAL, Lieuts. George R. Guild and Frederick C. Test; George Banta Pub. Co., Menasha, Wis. $1. An excellent little book, readable and nontechnical, for all militia and reserve corps officers.

51. LETTERS ON APPLIED TACTICS (with maps). Griepenkerl. Book Dept., $1.70. (A standard German work on minor tactics, the principles being well presented by a series of problems and solutions.)

52. DUTIES OF THE GENERAL STAFF. Von Schellendorf. Book Dept., $1.85. (A German work, probably the best on this subject.)

53. THE RIFLE IN WAR. Eames. Book Dept., $1.70. (A theoretical and practical investigation of the effects of rifle fire in battle.)

54. MANUAL OF MILITARY FIELD ENGINEERING. Beach. Book Dept., 90c. (For many years the best American manual. It is now largely superseded by No. 32, the Engineer Field Manual, but is still of interest and value.)

55. EXAMINATION AND REPAIR OF SIMPLE HIGHWAY BRIDGES. Sherrill. (A pamphlet of the Book Dept.)

56. MILITARY DEMOLITIONS. MacArthur. (A pamphlet of the Book Dept.)

57. INDIVIDUAL AND COMBINED MILITARY SKETCHING. Cole and Stuart. Book Dept., 95c. (Describes the methods for hasty mapping of relatively large areas under war conditions.)

58. SMALL PROBLEMS FOR INFANTRY. Capt. A. W. Bjornstad. Army Service Schools, 1916. Book Dept., 50c.

59. INFANTRY DRILL REGULATIONS, 1913. May be obtained from Supt. of Docs.; 35c. (Official drill regulations for infantry besides the principles of infantry duty in combat).

60. FUNDAMENTALS OF MILITARY SERVICE. Capt. Lincoln C. Andrews, U. S. A., pp. 428, illus., leather, $1.50, prepared under direction of Maj. Gen. Wood. Valuable semi-technical description of various arms of service being interestingly written and very instructive.

61. THE ENGINEER IN WAR. Maj. P. S. Bond, U. S. A. $1.50. A series of military lectures delivered in Chicago in 1916.

62. MILITARY PREPAREDNESS AND THE ENGINEER. Capt. E. F. Robinson, N. G. N. Y., $1.50. A good outline of engineer duties and company administration.

The British Spelter Embargo

The British Minister of Munitions, under order of Mar. 23, has placed an embargo on the sale and purchase of spelter. The order is published in the *Mining Journal*, London, Mar. 17, 1917, and is as follows:

1. No person shall, as from the date hereof, until further notice, purchase, sell, or except for the purpose of carrying out a contract in writing existing prior to such date for the sale or purchase of spelter, enter into any transaction or negotiation in relation to the sale or purchase of spelter situated outside of the United Kingdom except under and in accordance with the terms of a license issued under the authority of the Minister of Munitions.

2. No person shall, as from the date hereof, until further notice, purchase or take delivery of any spelter situated in the United Kingdom, except under and in accordance with the terms of a license issued under the authority of the Minister of Munitions, or sell, supply or deliver any such spelter to any person other than the holder of such a license and in accordance with the terms thereof; provided that no such license shall be required in the case of any sale, purchase or delivery of such spelter for the purpose of necessary repairs or renewals involving the use of not exceeding 1 cwt. of such spelter.

3. No person shall, as from the date hereof until further notice, except under and in accordance with the terms of a license issued under the authority of the Minister of Munitions, use any spelter for the purpose of any manufacture or work except: (a) For the purpose of a contract or order for the time being in existence certified to be within Class "A" in the order of the Minister of Munitions as to priority dated Mar. 8, 1917, and made in substitution for Circular L. 33. (b) For the purpose of necessary repairs or renewals involving the use of not exceding 1 cwt. of spelter.

MONTHLY RETURNS

4. All persons shall, in the first seven days of each month, commencing with the month of April, 1917, send in to the Director of Materials (A.M.2.C.), Ministry of Munitions, Hotel Victoria, London, W.C.2, monthly returns of: (a) All spelter held by them, in stock or otherwise under their control, on the last day of the preceding month, specifying the quality thereof. (b) All spelter purchased or sold by them for future delivery and not yet delivered on such last day, specifying the names of the sellers to or purchasers from them, and the quantity and quality, and time and place of delivery in each case, and the position of the spelter at the date of the return. (c) All spelter delivered to them during the preceding month and from whom purchased. (d) All contracts or orders existing on the last day of or entered into during the preceding month requiring for their execution the use of spelter, specifying the purposes thereof and the quality of the spelter to be used. (e) Such other particulars as to spelter as may be required by the Director of Materials. Notwithstanding the above, no return is required from any person whose total stock of spelter in hand and on order for future delivery to him has not at any time during the preceding month exceeded one ton.

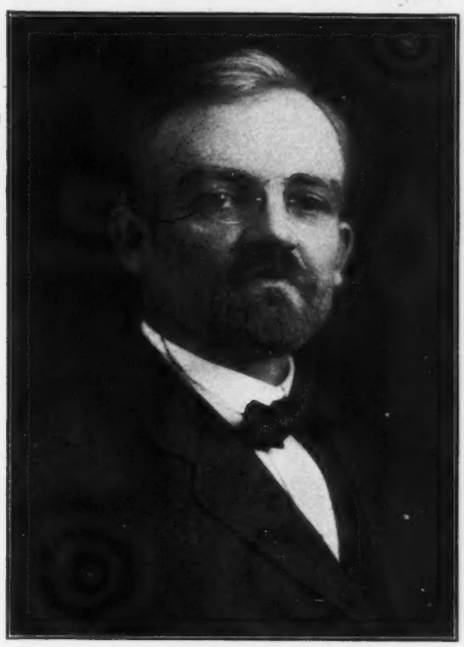
5. For the purpose of this order the expression spelter shall mean spelter of all qualities and shall include sheet and rolled zinc, scrap zinc, hard spelter, dross, zinc ashes, flux skimmings and zinc dust.

6. All applications for licenses should be made to the Director of Materials (A.M.2.C.), Ministry of Munitions, Hotel Victoria, London, and marked "Spelter License."

Every applicant for a license must state the amount and quality of metal required by him per month and the use to which it will be put. Any person acting in contravention of or failing to comply with the above order, or making a false return, will be guilty of an offense under the Defense of the Realm Regulations and be liable.

Prominent Men in the United States Geological Survey

GEORGE OTIS SMITH
Director



A. H. BROOKS
Geologist in charge of Alaskan investigations

H. D. McCASKEY
Chief of Division of Mineral Resources

F. L. RANSOME
Geologist in charge of metalliferous work

Anaconda Copper Mining Co.

The annual report of the Anaconda Copper Mining Co. for 1916 shows that during the year there was a total of 222,103 ft. of development work done, the equivalent of 42.06 miles, as compared with 35.31 miles in 1915. The shafts of the company were sunk to additional depths aggregating 2879 ft. The disclosure of ore by the development carried on during the year was very satisfactory. This is particularly true with reference to the deep levels of the Leonard mine on the east, the Diamond mine on the north and the Mountain Consolidated mine on the northwest portion of the district. New equipment was placed during the year on the Never Sweat, East Colusa, Moonlight and Emma mines. Additional air compressors were installed, and all old equipment was maintained in first-class condition.

Production and Treatment of Copper

The mines produced during the year 5,582,076 tons of ore and 7081 tons of precipitates; total of 5,589,157 tons.

The copper reduction works treated for all companies during the year 5,193,572 tons of ore and other cupriferous material at Anaconda and 813,495 tons at Great Falls. Of this amount 5,273,066 tons of ore was produced by company mines; 724,355 tons of ore was either purchased from or treated for other companies; 9647 tons of precipitates and cleanings from the old work at Anaconda and Butte was treated.

At Anaconda there were produced 287,082,079 lb. Cu, 10,624,747 oz. Ag and 81,393.059 oz. Au; at Great Falls there were produced 44,811,194 lb. Cu, 1,213,022 oz. Ag and 10,706.123 oz. Au; a total production at both Anaconda and Great Falls copper plants of 331,893,273 lb. Cu, 11,837,769 oz. Ag and 92,099.182 oz. Au. Of the total production at these plants, 307,395,092 lb. Cu, 10,790,706 oz. Ag and 92,099.182 oz. Au were produced from the mines of the company.

The zinc plants at Anaconda and Great Falls treated for all companies during the year 196,680 tons of ore and other zinkiferous material, of which amount 142,225 tons of ore was produced by company mines and 54,456 tons was purchased from other companies. At Anaconda there was produced during the year 8,320,522 lb. of electrolytic zinc and at Great Falls 12,585,917 lb., or a total of 20,906,439 pounds.

The new copper electrolytic and furnace refineries at Great Falls were completed and began operating in March, 1916. The output of the electrolytic tankhouse during the year was 127,620,000 lb. of cathodes, 56,062,000 lb. of which was melted into shapes in the new furnace refinery at Great Falls and the balance shipped to the plant of the Raritan Copper Works for melting. At the close of the year the electrolytic refinery was running at the rate of 16,000,000 lb. output per month and the furnace refinery at the same rate, both plants exceeding their respective estimated capacities 1,000,000 lb. per month.

Zinc Treatment and Leaching Plant Production

Perhaps the most important event of the year was the entrance of the company into the field as a large producer of high-grade electolytic zinc. In the circular letter addressed to the shareholders under date of Feb. 14, 1916, reference was made to the development by the Anaconda company of the electrolytic zinc process, and its importance from a metallurgical standpoint, in making possible the profitable extraction of not only the zinc content, but the precious metals often found in intimate association with zinc in the baser ores prevailing in many of the mining districts of the West. Starting from continued laboratory experiments, it was decided to take advantage of the favorable price of zinc and endeavor to put the business upon an operating basis. A small operating unit was constructed at Anaconda. The results obtained were such as to justify the management in extending this plant, until about September, 1915, it was producing zinc at the rate of 10 tons per day. It had early become apparent that the business promised to become an important factor in the operations of the company. Accordingly, after due consideration of suitable situations, it was decided to erect a plant for the treatment of zinc concentrates, capable of making an output of 100 tons of zinc per day, at Great Falls, this site being chosen on account of its availability to an abundant supply of cheap electric power, essential for the economic operation of the process. Construction was begun about the first of 1916 and was conducted diligently, so that by Sept. 11, 1916, the plant began operating, and at the close of the year was producing zinc at the rate of 20,000 lb. per day. The process worked so satisfactorily that it was demonstrated that with additional roasting capacity the output of zinc from the plant can be increased to 150 tons per day, and such additional roasting capacity is being installed as rapidly as possible.

A concentrator capable of milling 2000 tons of zinc ore per day, using the oil-flotation process, was constructed at Anaconda during the year. The plant began operating during September, 1916, and is milling all of the zinc ores mined by the company and also custom ores purchased.

The leaching plant at Anaconda treated during the year 525,500 tons of tailings from the concentrator dump, from which there was produced 3648 tons of cement copper. This output does not represent the capacity of the plant, as operations were curtailed on account of a shortage of sulphuric acid, the entire output of the sulphuric-acid plant at Anaconda being more urgently required for the concentrating and zinc operations of the company.

Subsidiary Corporations and Departments

The International Smelting Co.'s smeltery at Tooele, Utah, treated during the year 442,756 tons of copper ore, and 421,197 tons of lead ore, from which there were produced 20,041,089 lb. Cu, 117,976,091 lb. Pb, 5,549,776.55 oz. Ag, and 41,009.186 oz. Au. The smeltery at Miami, Ariz., treated 295,075 tons of concentrates and 37,890 tons of purchased ores, or a total of 332,965 tons, from which there were produced 181,518,396 lb. Cu, 257,543 oz. Ag, and 2,881.655 oz. Au.

The International Lead Refining Co.'s refinery at East Chicago, Ind., treated during the year 58,769 tons of lead bullion from the Tooele plant and 6148 tons of foreign ore and bullion, from which there were produced 108,099,116 lb. of common and corroding lead; 15,682,151 lb. of antimonial lead; 4,468,775 oz. Ag, and 20,580.053 oz. Au.

The Raritan Copper Works' refinery at Perth Amboy, N. J., treated for all companies during the year 233,596

tons of copper bullion and 4,531,771 oz. of silver bullion, from which there were produced 462,666,262 lb. Cu, 18,606,866 oz. Ag, and 167,024.248 oz. Au.

The coal mines at Diamondville, Wyo., produced 632,821 tons of coal; 403,386 tons was shipped to other departments of the company, 180,016 tons was sold commercially, and 55,418 tons was used at the coal mines. The mines at Washoe, Mont., produced 166,490 tons of coal; 94,008 tons was shipped to other departments of the company, 63,364 tons was sold commercially, and 9118 tons was used at the coal mines. The mines at Sand Coulee, Mont., produced 158,810 tons of coal; 119,516 tons was shipped to other departments of the company, 39,038 tons was sold commercially, and 257 tons was used at the coal mines.

The sawmills of the lumber department at Hamilton, Hope, Bonner and St. Regis cut during the year 105,495,846 ft. of lumber and purchased 30,005,910 ft., of which 91,321,061 ft. was shipped to the mines of the company, 80,800,144 ft. was sold commercially, 1,361,549 ft. was used at the mills for repairs and construction, 6,215,378 ft. was supplied to the factory for manufacturing, or a total disposition of 179,698,132 ft., decreasing the stock of finished lumber on hand 44,196,376 ft., leaving 50,971,698 ft. on hand on Jan. 1, 1917.

The other subsidiary departments of the company, including the electric-light, street railway, water and foundry departments at Anaconda, each did a record business. Extensive repairs, renewals and betterments were made in various departments. The subsidiary departments of the company showed a profit for the year of $1,295,119.

The Butte, Anaconda & Pacific Ry. transported during the year 8,416,003 tons of ore and freight, and 408,865 passengers. The gross earnings were $2,168,132; rental and miscellaneous receipts, $31,479; operating exepenses, $1,464,796; taxes, interest and rental of leased lines, $207,648; net income, $527,167. A dividend of 12% on the capital stock was paid, amounting to $300,000, leaving a surplus for the year of $227,167.

South American Operations and Explorations

In January, 1916, the following companies were organized under the laws of the State of Delaware: Andes Copper Mining Co., with an authorized capital of $50,000,000, divided into 500,000 shares, having a par value of $100 each; Potrerillos Railway Co., with an authorized capital of $5,000,000, divided into 50,000 shares, having a par value of $100 each; Andes Copper Co., with an authorized capital of of $50,000,000, divided into 2,000,000 shares, having a par value of $25 each.

The Andes Copper Mining Co. was organized for the purpose of acquiring, and did acquire, from William Braden all the mines, mining property and mining rights of the Potrerillos properties and the privileges incidental thereto. The Potrerillos Railway Co. acquired the concessions which had been granted by the government of Chile to William Braden, for the construction and operation of a railway in the republic of Chile, and will construct and operate a railway from the port of Chanaral to a connection with the longitudinal line of the Chilean government's railway, and from the station of Pueblo, Hundido, on that line, to the Potrerillos properties, a distance of approximately 60 miles.

The Andes Copper Co. is a holding corporation, which, under the plan of organization and finance decided upon, has secured all the issued stock of both the Andes Copper Mining Co., and the Potrerillos Railway Co., with the exception of directors' qualifying shares in each subsidiary company. When the Andes Copper Co. was organized, Anaconda was the owner of about 78% of the capital stock. Since that date, by purchase from William Braden, his associates and other shareholders owning small amounts of stock, the Anaconda Copper Mining Co. has acquired practically all the issued capital stock of the Andes Copper Co.

On account of the prices prevailing for construction material and the difficulty and uncertainty of securing deliveries of the same, it was decided by the management of the company that inasmuch as the Potrerillos properties could not, in all probability, be equipped in time to take advantage of the present metal markets, it was the better policy to defer the actual work of constructing the mining, milling and reduction plants with which the property must necessarily be equipped, until a more favorable period. In the meantime, however, development work has been carried on by means of churn drilling and underground openings for the purpose of blocking out and more definitely fixing the limits of the orebody at the Potrerillos mines. The result of this development has verified the earlier estimates made of the property and has shown that ore of profitable grade in excess of 100,000,000 tons exists on the property. As preliminary to the work of construction referred to, work has been started upon the Potrerillos railroad and its construction has been actively carried on during the past year.

In addition to the Potrerillos property, this company, through its associates in South America, has secured options on other mining properties in Chile and Peru, where exploration work is being actively conducted, but the results thus far obtained, while very encouraging, are not sufficiently definite to make any specific statements in regard thereto.

Investments in Stocks of Other Companies

During the year Anaconda added materially to its investments in securities of other companies, expending $7,968,836 in so doing. This amount includes the total cost of the stock of the Andes Copper Co. acquired to Dec. 31, 1916. The principal purchases of other stocks were: 20,740 shares of Alice Gold and Silver Mining Co., making the total holding 382,912 shares, out of a total of 400,000 issued; 26,100 shares of Greene Cananea Copper Co., making a total holding of 56,900 shares; 50,000 shares of Inspiration Consolidated Copper Co., making a total holding of 200,000 shares; 188,300 shares of Butte Copper and Zinc Co. The other acquisitions of stock represent largely the purchases of shares of stock of subsidiary companies organized and financed in connection with the general operations of the company.

Under the lease which was acquired by the company in July, 1915, on the Emma Mine of the Butte Copper and Zinc Co., the Emma shaft was dewatered to the 800-ft. level, the old workings cleaned out and repaired, and prospecting work instituted, resulting in the opening up on the 800-ft. level of the mine of a large body of ore carrying good percentages of zinc, lead and silver. During the year this mine produced 13,029 tons of ore, chiefly from development work. The ore was concentrated at the zinc concentrator of the company at Anaconda, and the concentrates obtained therefrom were shipped to and treated

by the electrolytic zinc plant at Great Falls. The Emma shaft is being sunk below the 800-ft. level, and a crosscut is being extended southerly on the 1600-ft. level of the Original mine, which should cut the Emma vein approximately 700 ft. below the 800-ft. level of the Emma, within a comparatively short time.

There was $7,113,463 charged off for depreciation and obsolescence of mining plants, smelteries, refineries, etc. In explanation of the increase in this item over the normal charge on this account, it is stated that $3,668,226 of this amount was the book value of plants which, by reason of changes in metallurgical methods, or replacements, have either been dismantled or become obsolete and will not be required or used in conducting the normal operations of the company. During the present period of forced production some of these plants which have not been dismantled are still being used; but inasmuch as such use is regarded as temporary, it was proper to charge them off the books of the company at this time.

Viewed from the standpoint of operations, 1916 was the most successful year in the corporate life of Anaconda—successful not only in the profits that were earned, but likewise successful in the realization of all expectations that were entertained concerning the probable accomplishments of its plant improvements, betterments and extensions. Beginning with 1914 there was expended on these accounts, to Dec. 31, 1916, the sum of $13,645,908. At the close of business for 1916 the additional profit that had been secured as a result of this expenditure was $16,494,485. Thus, all the money expended had been returned with the additional sum of $2,848,576, from the benefits derived from the improvements and additions to plants.

⌘

Price of Zinc to the Government

The Zinc Committee of the Advisory Commission of the Council of National Defense, appointed by B. M. Baruch in charge of raw materials of the Advisory Commission of the Council of National Defense is as follows:

Chairman, Edgar Palmer, president, New Jersey Zinc Co.
Charles W. Baker, president, American Zinc, Lead and Smelting Co.
Sidney J. Jennings, vice president, United States Smelting, Refining and Mining Co.
Thomas F. Noon, president, Illinois Zinc Co.
N. Bruce MacKelvie, president, Butte & Superior Mining Co.
Charles T. Orr, president, Bertha A. Mining Co.
C. F. Kelley, vice president, Anaconda Copper Mining Co.
Secretary, A. P. Cobb, vice president, New Jersey Zinc Co.

The purpose of this committee is to insure the Government of its supply of zinc during the war and to secure the coöperation of the zinc producers of the country in taking care of whatever needs may arise.

The following prices for slab zinc have been fixed with Government approval:

Grade A—11½c. per lb.
Grade B—11c. per lb.
Grade C—9c. per lb.

The price of Grade C is protected against decline.

These prices are in carload lots with freight allowed to New York delivery rate points.

During the war Grade A metal has sold as high as 42c. per lb., and the market price at the time of making these prices was 18c. per lb. Grade C metal has sold as high as 27½c. per lb., and the market price at the time of making these prices was 10c. per pound.

Letters have been sent to zinc producers throughout the country asking the amounts they are willing to supply to the Government.

Grade A is what is commonly known as "High Grade," B is "Intermediate" and C is "Prime Western."

⌘

Chronology of Mining for April, 1917

Apr. 1—Milling begun by Alaska Juneau Gold Mining Co.—Yuba No. 16 gold dredge, with 18-cu.ft. buckets and double tailing stackers to reclaim Yuba River channel, started digging near Hammonton, Calif.—Homestake Mining Co. in South Dakota advanced wages of employees receiving $3 to $5 per day from 16% to 10% respectively—Potash plant erected at Borosolvay, near Searles Lake, Calif., by Pacific Coast Borax Co. and Solvay Process Co., began operation.

Apr. 2—Ohio Copper Co. of Utah acquired all stock and majority of bonds of Bingham Central Railway Co., which owns the Mascotte tunnel, which is the outlet for the Ohio ore.

Apr. 4—Sunnyside and Gold Prince mines in San Juan district, Colorado, optioned to U. S. Smelting, Refining and Mining Exploration Co.

Apr. 5—New mining tax bill passed by Ontario legislature, increasing mainly the tax on nickel and nickel-copper mines.

Apr. 6—United States declared state of war existed with Germany.

Apr. 7—Herbert C. Hoover appointed by United States Council of National Defense to head American commission on food supply and prices.

Apr. 10—Announcement that Williams Harvey Corporation, controlled jointly by Williams, Harvey & Co., Ltd., and the National Lead Co., would erect 300-ton tin-smelting plant on Jamaica Bay, Long Island—Nichols Copper Co. broke ground at its Laurel Hill refinery for a new plant to treat the gold and silver slimes obtained in electrolytic copper refining.

Apr. 16—Chile Copper Co. increased capital from $110,000,000 to $135,000,000 and authorized bond issue of $100,000,000, of which $35,000,000 is to be issued at once for extensions to plant to triple present capacity—Suit of Minerals Separation vs. Butte & Superior for flotation-patent infringement begun at Butte, Mont.

Apr. 21—Caving of old workings in Douglas Island mines along the Gastineau Channel caused flooding and closing of Alaska Treadwell, Seven Hundred and Alaska Mexican mines; Ready Bullion mine saved by bulkhead.

Apr. 22—Frederic Anton Eilers, long a member of the executive committee of the American Smelting and Refining Co., died at his home at Sea Cliff, Long Island.

Apr. 23—Fire in Anaconda's Modoc mine at Butte resulted in temporary closing of Modoc and High Ore mines, the Speculator and Granite Mountain mines of the North Butte company and the Butte-Ballaklava mine.

Apr. 24—Sale of Big Jim gold mine at Oatman, Ariz., to United Eastern Mining Co. ratified by Big Jim stockholders—Wages advanced 25c. per shift in Mammoth section of Tintic district in Utah.

Apr. 27—Leaching begun at New Cornelia Copper Co.'s 5000-ton plant at Cornelia, in the Ajo district of Arizona.

Apr. 28—Seven men killed by powder gas on entering unventilated 1400 level of Mountain King gold mine in Mariposa County, California.

Butte & Superior's Flotation Results

The accompanying table showing the results secured by flotation during the months of March, 1915, 1916 and 1917, and part of the data submitted to the Federal Court at Butte. The tonnages are the actual amounts treated by flotation and not the entire amount treated at the mill. Extraction percentages, based on both concentrates and tailings, are shown in an auxiliary table, but are not part of the court record.

The Butte & Superior management expects to increase the grade of concentrates by the installation of additional cleaner cells for the purpose.

COMPARATIVE FLOTATION RESULTS OF BUTTE & SUPERIOR MINING CO., FOR THE MONTH OF MARCH, 1915, 1916 AND 1917

	1917		1916		1915	
Ore treated	47,202.599 tons		52,089.4335 tons		36,812.819 tons	
Concentrates recovered	10,642.6505 tons		12,199.0195 tons		7,365.615 tons	
Assay returns of heads	12.4893	% Zn.	13.7639	% Zn.	12.1077	% Zn.
	.8578	% Pb.	.7238	% Pb.	.7080	% Pb.
	.1598	% Cu.	.1572	% Cu.	.1641	% Cu.
	1.8901	% Fe.	1.2916	% Fe.	1.4801	% Fe.
	1.4681	% Mn.	1.2720	% Mn.	1.4340	% Mn.
	73.0481	% Insol.	71.7590	% Insol.	72.9068	% Insol.
	4.8032	Oz. Ag	5.8663	Oz. Ag	5.8316	Oz. Ag
	.00584	Oz. Au	.0089	Oz. Au	.00935	Oz. Au
Assay returns of concentrates	47.207	% Zn	53.752	% Zn	52.237	% Zn
	3.700	% Pb	3.046	% Pb	2.665	% Pb
	.489	% Cu	.598	% Cu	.566	% Cu
	3.000	% Fe	1.971	% Fe	2.126	% Fe
	.400	% Mn	.295	% Mn	.873	% Mn
	16.500	% Insol.	10.107	% Insol.	10.637	% Insol.
	18.240	Oz. Ag	23.388	Oz. Ag	24.573	Oz. Ag
	.0267	Oz. Au	.0347	Oz. Au	.0430	Oz. Au
Assay returns of tailings	1.997	% Zn	1.3138	% Zn	2.1467	% Zn
	.115	% Pb.	.0600	% Pb	.1477	% Pb
	.040	% Cu	.0330	% Cu	.0300	% Cu
	.800	% Fe	.8400	% Fe	.5300	% Fe
	1.650	% Mn	1.5300	% Mn	1.4700	% Mn
	89.600	% Insol.	90.4000	% Insol.	89.9000	% Insol.
	.840	Oz. Ag	.9700	Oz. Ag	1.2980	Oz. Ag
	.0012	Oz. Au	.0025	Oz. Au	.0026	Oz. Au

PERCENTAGE RECOVERIES

	March 1917	1916	1915
Based on concentrates	85.285	91.490	86.387
Based on tailings	84.000	90.452	82.259

Conditions at Alaska Treadwell Mines

SAN FRANCISCO CORRESPONDENCE

The physical conditions of the Treadwell-Seven Hundred-Mexican mines, on Douglas Island, Alaska, remain unchanged. The latest reports received at the San Francisco office do not encourage the probability of attempting to cofferdam the top water off and pump out the mines. Even if the subsidence were shown not to extend far enough into Gastineau Channel to prohibit it, the cost of such undertaking would be greater than the value of the ore would warrant. The ore has for some time been decreasing in value as depth was gained, and the diamond drills showed still further decrease below the 2700 level. Though the ore could have been mined and milled at a profit had the ground not subsided, the only profitable method of extraction at present feasible is through the deepening of the Ready Bullion shaft to the 3000-ft. point and drawing the ore off through the Ready Bullion workings. This method will be followed; but whether or not the shaft will be deepened ahead of the requirements of the Ready Bullion operation has not been decided. If in the course of exploration below the 2700 level the ore in the flooded mines should show an appreciable increase in per ton value, then the cost and the corresponding results of lifting the water out of the subsided area will be considered. The Treadwell mill is of course out of commission, and several hundred men are out of employment. The 500 men from the mine were all out within an hour, and none was lost, although two of them came out afloat on the rising water.

The directors of the Alaska Treadwell Gold Mining Co. on Apr. 30 voted to double the capital stock, increasing it to $10,000,000, divided into 400,000 shares of $25 par value. The company was also authorized to acquire by exchange outstanding shares of new capital stock of Alaska United Gold Mining Co. and Alaska Mexican Gold Mining Co. upon conditions and at such ratio as a majority of the shareholders shall determine. No report on the subsidence of the Treadwell-Seven Hundred-Mexican was given out by the directors.

Foreign Trade in Copper

Exports of copper from the United States in February, 1917, are reported by the Department of Commerce as follows:

	Lb.
Ore and concentrates	417,296
Unrefined, in bars, pigs, etc	246,132
Refined, bars, etc	69,642,592
Old and scrap	4,404
Plates and sheets	1,501,566
Wire	884,132
Total	71,696,122

The weight of ore exported in February was 4012 tons; of concentrates, 537 tons.

Imports of copper into the United States in February, 1917, are reported by the Department of Commerce as follows:

	Lb.
Ore and concentrate contents	13,247,37.7
Matte and regulus	534,042
Unrefined, in bars, pigs, etc	21,664,357
Refined, in bars, etc	2,684,454
Old, etc., for manufacture	2,626,702
Composition metal, copper chief value	42,172
Total	40,799,104

Material imported in February was 41,639 tons ore, 13,449 tons concentrates and 717 tons matte and regulus.

Utah Copper Co.

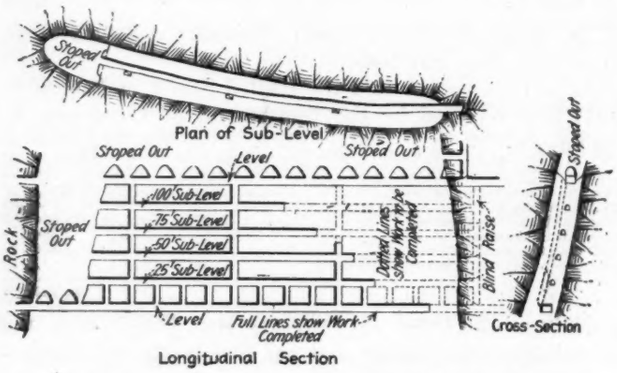
The report of the Utah Copper Co. for the first quarter of 1917 shows production of 42,866,316 lb. of copper; 13,913,811 lb. in January, 13,459,829 lb. in February and 15,512,676 lb. in March. In addition there was a total of 174,134 lb. of copper contained in ore shipped direct to the smeltery.

The total quantity of ore milled was 2,377,900 tons, averaging 1.4299% copper, average extraction being 63.06%. The average cost per pound of copper was 10.843c. after making allowances for smelter deductions and crediting miscellaneous income, including Bingham & Garfield Ry. Co. earnings. The high cost of copper, compared with 7.498c. per lb. in the last quarter of 1916, was partly due to the extremely severe winter weather and partly to the increased cost of labor, but principally to the increased State and Federal taxes. The amount set aside for the quarter's taxes, based on existing laws, was equivalent to 3.142c. per lb. of copper. Net profit from milling operations was $5,775,605, other income from rents, dividends from Nevada Consolidated Copper Co. and Bingham & Garfield Ry. Co., brought the total profits during the quarter up to $7,246,318. Dividends of $5,685,715 were paid, leaving net surplus for the quarter of $1,560,603. Earnings are based on 26.173c. per lb. for copper.

Substoping Mining at the Chatham Mine, Michigan*

The principal method of mining at the Chatham mine, Michigan, is what is known as substoping. The orebodies are comparatively small, narrow and irregular, varying in width from 10-50 ft. and usually not running more than 300-400 ft. in depth. In many places rock bunches stretch entirely across the orebody. The dip varies from 60-90 deg. and the ore differs in structure from soft limonite to hard blue hematite, both often being mixed in the same orebody.

The levels of the Chatham mine are 125 ft. apart vertically. On these levels, drifts, and crosscuts if necessary, are driven in the ore in such a manner that raises may be put up about 25 ft. apart and chutes built in them. A new raise is started as soon as the drift has advanced a sufficient distance from the last one. The raises are extended 25 ft. As soon as the chutes are built, the drift is timbered to prevent any caving of the back when stoping is being done above. At some convenient place in the ore, two of the raises, about 50 ft. apart, are continued through to the level above. Generally one of



PLAN AND SECTION SHOWING SUBSTOPING METHOD USED AT CHATHAM MINE

these two raises is near the end of the orebody, so that stoping may later be started around it. Sublevels, or "subs," are then put in every 25 ft., vertically connecting these raises; this makes four "subs" between each level. One of the raises is then ready to be used for ladderway and pipeway and another for a mill. The "subs" are then continued toward the end of the orebody. Whenever a breast of the "subs" gets too far from the original mill for efficient mucking, a raise is put through from the 25-ft. "sub" below. The ore is easy to handle on the 25-ft. sublevels, because, as before stated, the raises are put to this "sub" as fast as the drift advances. The "subs" are continued into the rock a short distance beyond the end of the orebody and then connected with a raise, called a "blind raise," which is used for ladderway and pipes and serves as an exit when this end of the orebody is being stoped.

If stoping is started at any point except at the farthest end of the orebody from the blind raise, then a blind raise will be required at both ends of the orebody; therefore stoping is generally started around the first long raise put up, which is at the end of the orebody. There is an advantage, however, in beginning near the middle of the orebody, in that stoping can then be done toward both ends of the orebody at the same time, twice as many working places being thus provided.

The stope is started by drilling uppers and down holes on each "sub" around the raise and slicing out the ore toward the foot and hanging walls until a wide bench is formed, after which more stope holes are drilled. This process is repeated until the full width of the orebody is opened into a stope reaching from the 25-ft. "sub" upward. The level above is worked back at the same time. Particular attention is given to funneling out the raises below the 25-ft. "sub," so that large chunks of ore can work down close to the mouth of chute where they can be easily blasted. Stoping is continued by slicing out a well-covered bench from the "sub" toward the foot and hanging. When the rock walls have been reached, uppers and down holes are drilled from the benches, first nearer the rock and then back toward the "sub." When this is finished, another bench is started from the drift and continued to foot and hanging and the above operation repeated. When a rock bunch is encountered which is large enough to be left for a pillar from foot to hanging, a raise is put up along the rock on the opposite side from the stope and stoping again started in the way previously described. If the rock bunch is smaller and cannot be left, it is drilled separately and as soon as the chutes are empty, it is blasted down and hoisted for rock.

Blasting is done as often as possible, so that a great amount of ore does not have to be blasted at one time, for otherwise the ore will run on the 25-ft. "subs" and make the miners there do a lot of shoveling. Generally 10-ft. holes are deep enough, but occasionaly 14- and 16-ft. holes are needed. The angle of the face of the stope depends upon the character of the ore; if the ore is soft and subject to caving, the stoping on the upper "subs" is kept a little farther advanced than on the next ones below. If the ore stands well, the face is carried almost vertical.

Because the orebodies are small, often those on one level are developed and mined during the same season. Stoping is, therefore, begun before the subdrifts are finished, as is shown in the sketch of the longitudinal section; the heavy lines indicate entry work completed at the same time that the stope is well started, and the dotted lines show entry work yet to be completed while stoping is still being done. The system has the following advantages: Little development work is required before stoping may be begun; all the ground broken can be hoisted at once; the method may be used to good advantage in ground that is too soft and not uniform enough for back-stoping; the rock bunches found in the ore are disposed of with little trouble; but the system has the disadvantage that the large amount of drifting and raising required may make the method uneconomical in hard ore.

*Paper presented by F. J. Smith, superintendent of the Brule Mining Co., Iron River, Mich., at the annual meeting of the Lake Superior Mining Institute, Birmingham, Ala., March, 1917.

Tasmania's Mineral Production for 1916 has been officially reported by the Secretary for Mines as follows, the items being arranged in order of descending value: Blister copper, 6305 tons; tin ore, 2855 tons; silver-lead ore, 11,229 tons; gold (fine gold including gold contained in blister copper), 15,790 oz.; coal, 55,575 tons; wolfram, 86 tons; iron pyrites, 14,005 tons; osmiridium, 222 oz.; copper and copper ore, 97 tons; shale, 1286 tons; bismuth, 3½ tons; barytes, 83 tons; asbestos, 15 tons. The total value of the mineral products was £1,521,050

Company Reports

Yukon Gold Co.

The annual report of the Yukon Gold Co., whose original and principal operation is in Yukon Territory, Alaska, shows that the gross profit from operations in 1916 was $2,092,300, or approximately the same as that of the preceding year. The amount written off to depreciation and amortization either directly or through operating costs was $668,967. There was added to surplus account $47,510, after distributing $1,050,000 in dividends.

The company several years ago inaugurated the policy of adding new properties to take the place of those being exhausted and in pursuance of this policy acquired during 1916, either by purchase or lease, properties in California, Nevada and Idaho, with an estimated gross gold content at present in excess of $8,000,000 and with considerable further development work to be done. The company's proportion of net profit in these additional properties on the basis of the present development is estimated to be approximately $3,500,000. During the past year the company has expended, on account of new properties and the equipment of properties previously acquired, a total amount of $1,893,105.

The Yukon-Alaska Trust referred to in the 1915 annual report was duly formed and acquired the eight serial notes of $625,000 each, bearing interest at the rate of 5% per annum, representing the loan to the Yukon Gold Co., of $5,000,000.

The acquisition of its interest in the properties of the Elkoro Mines Co., at Jarbidge, Nev., a lode mine marks a departure in the character of operations which have heretofore been confined to placers.

PROPERTY AND EQUIPMENT

In June, 1915, the company undertook the examination, and later the development, of the Long Hike and O. K. groups of mining claims, in the Jarbige district, Elko County, Nev. Development work on these properties was prosecuted steadily for seven months, with the result that there was blocked out in these two groups alone approximately 214,000 tons of ore, having a value of $3,200,000. The workings on the Long Hike group on Jan. 1, 1917, had reached a depth of 600 ft. below the point where the ore was first discovered. Developments on the O. K. group had reached a total vertical depth of 250 ft. in a vein similar in character and approximately parallel to the Long Hike vein.

All of the above properties and rights which have been acquired by the company have been assigned to the Elkoro Mines Co., which company was formed in accordance with agreements made with the owners of the principal mines at the time the business was entered into. The Yukon Gold Co. owns 60% of the stock of the Elkoro Mines Co., and has an option to purchase an additional 10% of the stock at any time before July 1, 1917.

ADDITIONAL PROPERTIES SECURED

During 1916 the company examined and acquired, by leasing agreements, three additional gold dredging properties as follows:

Cœur d'Alene Mining Co., on Prichard Creek, near Murray, Idaho, the developed area of which contains about 8,500,000 cu.yd., with an estimated gold content of over $1,350,000.

River claims and leases on the North Fork of the American River, containing aproximately 7,000,000 cu.yd., with estimated gold content of over $1,000,000. This ground is near the company's American River dredge, which will be moved to the North Fork property when its present work is completed.

Trinity Exploration and Carr properties, in Trinity County, California, adjacent to the company's present holdings. These new properties are estimated to contain approximately 21,000,000 cu.yd. of gold-bearing gravel, with a gross content estimated at $3,000,000.

The company's proportion of the estimated net profit to be derived from these three leasing operations is approximately $2,000,000.

During the year two new dredges of all-steel construction were completed and placed in operation; one on the Trinity property, of 9-cu.ft. bucket size, and a similar dredge on the Yuba property. The 3½-cu.ft. dredge which was shipped to Greenstone Creek, Ruby District, Alaska, during the fall of 1915, was completed and placed in operation early in May. In the Yukon, Dredge No. 3 was moved to Bear Creek, rebuilt and placed in operation during the latter part of August. Dredge No. 9 is now being dismantled and made ready for moving to the Cœur d'Alene property.

In the hydraulic mines a tunnel 800 ft. long was driven from Bonanza Creek to permit washing all the gravels at Oro Fino Hill mine. Various small changes were made in equipment.

In connection with the development of the Jarbidge properties, the company installed equipment consisting of small power plant, tramway, diamond-drill outfit, office, warehouse, bunkhouses, etc. Plans are under way for the construction of a mill. The first unit, of 100 tons capacity, is expected to be completed during 1917.

DREDGE OPERATIONS

The Dawson dredges began their tenth season on May 15, and operated to Oct. 26, which is longer than the usual season in the Yukon, the weather remaining mild during October until late in the month. The average length of the dredging season was 145 days.

The seven dredges mined an area of approximately 128 acres, containing 5,433,052 cu.yd., which produced $2,276,000, an average of 41.89c. per cu.yd. The average cost, including depreciation, was 23.32c. per cu.yd., which is 3.14c. per yd. lower than the previous year and is the lowest cost yet obtained for this operation. A greater yardage was handled than in the preceding season, and the costs were lower, but the net profit for the year was slightly lower, due to the lower gold content of the material mined The average value of the gravel remaining will continue to be lower than that mined in the past few years.

During the season a total of 339,127 sq.yd., or 53.4% of the ground handled, was thawed by steam. Thawing results were highly satisfactory.

The Greenstone Creek dredge operated from May 17 to Oct. 31. It handled 206,508 cu.yd. of gravel, having a total value of $179,122, or 86.7c. per cu.yd. Operating costs were $166,591, or 80.6c. per cu.yd. This dredge met with operating difficulties in the early part of the season, on account of the bedrock conditions and difficulty in handling and washing the material dredged, which necessitated some changes in the dredge machinery. The operation in the latter part of the season was normal and up to expectations.

The Iditarod dredge began operations on Apr. 28 and closed down for the winter season on Nov. 14, making a total operating season of 199 days, which is three days longer than last year. Favorable operating conditions and good running time during the season produced the best results which have been recorded for this operation. The dredge handled 1,015,920 cu.yd., which produced gold to the value of $971,071, an average value of 95.6c. per cu.yd. The yardage dredged was 88,964 more than in 1915, a gain of 9.5%. The production was $125,106 greater than in the previous season. The average cost, including depreciation, was 39.8c. which is 1.1c. higher than in 1915, due primarily to the greater amount of steam-thawed ground handled. The operating profit increased $79,017.

The three California dredges operating on the American River, Feather River and Butte Creek handled 4,032,476 cu.yd. of gravel, which yielded gold to the value of $414,214. The average cost for the three dredges was 3.94c. per cu.yd., depreciation included, which is a low record for this operation. The American River dredge was idle for a time on account of low water; otherwise normal conditions prevailed.

The new Yuba dredge started operations on Oct. 30. Bedrock was reached on Dec. 15. The operation of this dredge has been entirely satisfactory.

The Trinity dredge started on its trial run on Nov. 13. Some defects of material developed, and difficulties in handling the heavy gravel were encountered, which necessitated closing down the dredge for repairs and alterations. Operations will be resumed as soon as these repairs can be completed.

The yardage mined amounted to 2,245,084 cu.yd., which produced $435,666, at a cost of $266,369, equivalent to a cost of 11.9c. per cu.yd. The total water used was 489,625 miner's inches, as compared with 494,755 miner's inches in 1915. The duty of the water was 4.60 cu.yd. to the miner's inch.

The Twelve Mile Water System was operated from May 4 to Sept. 30 inclusive, a total of 151 days. The total delivery was 453,960 twenty-four hour miner's inches. The average daily delivery was 3006 miners inches. The ditch was operated for 88% of the possible time. The principle cause of lost time was washouts on Kentucky Point and Noble Creeks.

Leases on claims owned by the company in the Yukon and Iditarod, together with the return for water used on other than company ground, also assay-office cleanings, yielded a total of $94,804, at a cost of $3904.

SUMMARY OF OPERATING RESULTS

	Production	Working Costs	Operating Gain
Dawson dredges	$2,276,074.15	$1,266,884.24	$1,009,189.91
Dawson hydraulics	435,666.47	266,368.59	169,297.88
Iditarod dredge	971,071.04	404,462.10	566,608.94
Ruby dredge	179,121.78	166,490.81	12,630.97
California dredging	426,857.99	183,125.90	243,732.09
Miscellaneous operations	94,803.64	3,903.83	90,899.81
Total operations	$4,383,595.07	$2,291,235.47	$2,092,359.60
Non-operating income			9,341.79
Total income			$2,101,701.39

From the total income, as shown, were deducted: Royalties paid, $362,852; amortization, $250,647; interest charges, general expense, and examination, $390,691; making a total deduction of $994,190.

Calumet & Hecla Mining Co.

During the year 1916 the Calumet & Hecla Mining Co., of Michigan, produced 76,762,240 lb. of copper. Of this amount 71,349,591 lb. was produced from the mine and 5,412,649 lb. was recovered from the sand bank at Torch Lake. The price received for copper varied from 22½c. to 35½c. per lb.

Comparative results of operations for the cost for the past four years, including Torch Lake operations are:

COMPARATIVE RESULTS OF OPERATIONS

	1913	1914	1915	1916
Tons of rock treated	2,035,625	2,592,462	3,188,583	3,166,274
Mine cost per ton of rock (excluding construction)	$2.38	$1.85	$1.71	$2.03
Pounds of refined copper produced from mine	45,016,890	53,691,562	71,030,518	71,349,591
Pounds of copper per ton of rock	22.11	20.70	22.28	22.53
Cost per pound for construction	1.54c.	1.00c.	0.47c.	0.60c.
Total cost per pound of copper produced	14.25c.	11.35c.	9.33c.	11.63c.
Price per pound received for copper sold	15.77c.	14.01c.	18.11c.	25.48c.

COMPARATIVE RESULTS OF OPERATIONS ON CONGLOMERATE LODE

	1913	1914	1915	1916
Tons of rock treated	1,175,259	1,439,986	1,739,984	1,727,794
Mine cost per ton of rock (excluding construction)	$2.99	$2.37	$2.13	$2.63
Pounds of copper produced	32,731,768	37,996,045	51,738,588	51,785,016
Pounds of copper per ton of rock	27.85	26.38	29.74	29.97
Total cost per pound of copper produced	12.67c.	10.42c.	8.69c.	10.75c.
Shaft sinking	172.5 ft.	228.3 ft.	201 ft.	0 ft.
Drifting	5,929 ft.	4,339 ft.	5,522 ft.	5,142 ft.
Crosscuts and foot-wall drifts	0 ft.	0 ft.	0 ft.	0 ft.

DEPTHS OF OPERATING SHAFTS ON CONGLOMERATE LODE

Calumet Nos. 5 and 6	6,155 ft., to boundary to 60th level.
Calumet No. 4	7,995 ft., to boundary to 81st level.
Calumet No. 2	6,186 ft., sinking permanently discontinued at 63d level.
Slope shaft	1,588 ft., below 57th level or 185 ft. under 66th level.
Hecla No. 6	7,874 ft., 133 ft. under 79th level.
Hecla No. 7	7,977 ft., 140 ft. under 80th level.
South Hecla No. 8	6,102 ft., sinking permanently discontinued at 63d level.
South Hecla Nos. 9 and 10	8,132 ft., 142 ft. under 82d level.

SHAFT PILLARS AND ARCHES

About 78 drills were at work during the year removing shaft pillars and cleaning up arches and the backs of old stopes. A total of 476,310 tons was secured from these operations. In Nos. 6 and 7 shafts, Hecla branch, the drifts were advanced 719 ft., opening ground of first quality.

In January a fire occurred in an old level in No. 5 shaft, Calumet, but caused little damage.

RESULTS OF OPERATIONS ON OSCEOLA LODE

	1913	1914	1915	1916
Tons of rock treated	842,162	1,152,476	1,448,599	1,438,480
Mine cost per ton of rock (excluding construction)	$1.53	$1.19	$1.07	$1.32
Pounds of copper produced	12,051,238	15,695,517	19,291,930	19,564,575
Pounds of copper per ton of rock	14.31	13.62	13.32	13.60
Total cost per pound of copper produced	12.62c.	10.20c.	9.71c.	11.84c.
Shaft sinking	281 ft.	103 ft.	0 ft.	139 ft.
Subshaft sinking	0 ft.	0 ft.	0 ft.	0 ft.
Drifting	7,252 ft.	6,698 ft.	10,206 ft.	16,443 ft.
Foot drifts	0 ft.	0 ft.	0 ft.	0 ft.
Crosscuts	0 ft.	0 ft.	0 ft.	0 ft.

DEPTHS OF SHAFTS ON OSCEOLA LODE

No. 13	3,232 ft.	No. 16	3,274 ft.
No. 14	2,958 ft.	No. 17	1,938 ft.
No. 15	3,002 ft.	No. 18	1,460 ft.

The openings on this lode show about the same grade of rock as in 1915. The product secured from foot-wall stopes was about 33⅓% of the total product from this branch. Shaft openings are so far in advance of drifts that, with the exception of 139 ft. at No. 17, no sinking has been done during the year.

There were no changes of note in the mills in 1916, and all stamps were going uninterruptedly. Experiments with oil flotation have been under way on a laboratory scale for over a year with very encouraging results. Two 50-ton mineral separation machines are now installed to treat various products, and there is every reason to believe that the process will be a success in treating slimes.

Both the No. 1 and the No. 2 regrinding plants operated satisfactorily throughout the year. Little progress was made in remodeling No. 1 plant, but the work should be finished during 1917. The comparative results on mill tailings are as follows:

RESULTS OBTAINED FROM MILL TAILINGS

	No. 1	No. 2	Total
Tons coarse tailings crushed	364,581	182,705	547,286
Pounds per ton in material treated	13.98	13.98	13.98
Pounds copper saved per ton	3.79	4.98	4.18
Pounds copper produced	1,380,344	909,453	2,289,797
Cost per pound, excluding smelting and selling	6.32c.	4.30c.	5.51c.

The leaching plant was started on a limited scale in July, 1916, and at the end of the year was but half in commission owing to slow deliveries of material. The whole plant of 2000 tons' daily capacity will be in operation before spring, and results are so satisfactory that an addition of 2000 tons' capacity has been contracted for.

The present plant has capacity only for sand tailings from No. 2 regrinding plant, and the addition will take care of sands from the stamp mill. Operated on this limited scale, the cost, exclusive of smelting and selling expense, was under 6c. per lb. of copper produced.

The reclamation plant ran continuously in spite of a severe winter. With temperature below zero for the greater part of 10 weeks and with 18 in. of ice on Torch Lake the dredge managed to keep going without delay. The results of this operation, including leaching, follow:

RESULTS OF DREDGING AT TORCH LAKE

	Year 1916	Since Starting
Tons tailings treated	545,727	727,459
Pounds per ton in material treated	21.06	21.24
Pounds copper saved per ton	9.92	9.62
Pounds copper produced	5,412,649	6,995,451
Cost per pound, excluding smelting and selling	4.58c.	4.39c.

On July, 15, 1916, the fiftieth anniversary of the opening of the mine was celebrated by a general holiday, with appropriate exercises. Long service medals were given to 1371 employees. The 169 who had served for more than 40 years received gold medals; the 380 who had served between 30 and 40 years, silver medals, and the 822 who had served between 20 and 30 years, copper medals.

The 10% premium for the first six months of the year, announced Dec. 31, 1915, was continued throughout 1916, together with an additional payment of 25c. per day for each day worked from July 1 to Dec. 31, if the person was in the employ of the company on the latter date; this payment to be made on the first payday in January, 1917. On Dec. 13 notices were posted announcing that the 10% premium now in force would be continued until July 1, 1917, and that from Jan. 1 to July 1, 1917, a 50c. bonus for each day worked will be paid employees on regular paydays.

FINANCIAL STATEMENT

During the year dividends of $75 per share were paid amounting to $7,500,000 and making a grand total of $136,750,000 paid to date. Current assets amounting to $17,497,864 exceed current liabilities by $10,758,601.

The company owns stock in the following companies:

98,048 shares Ahmeek Mining Co.	of a total issue of	200,000 shares
41,000 shares Allouez Mining Co.	of a total issue of	100,000 shares
41,500 shares Centennial Copper Mining Co.	of a total issue of	90,000 shares
19,400 shares Cliff Mining Co	of a total issue of	60,000 shares
50,100 shares Gratiot Mining Co.	of a total issue of	100,000 shares
32,910 shares Isle Royale Copper Co.	of a total issue of	150,000 shares
152,977 shares La Salle Copper Co.	of a total issue of	302,977 shares
39,288 shares Laurium Mining Co.	of a total issue of	40,000 shares
32,750 shares Osceola Consolidated Mining Co.	of a total issue of	96,150 shares
50,100 shares Superior Copper Co.	of a total issue of	100,000 shares
42,602 shares White Pine Copper Co., common	of a total issue of	85,320 shares
34,259 shares White Pine Copper Co., preferred	of a total issue of	34,759 shares
3,482 shares Calumet Transportation Co.		
1,000 shares Great Lakes Transit Corporation preferred.		
1,000 shares Great Lakes Transit Corporation common.		

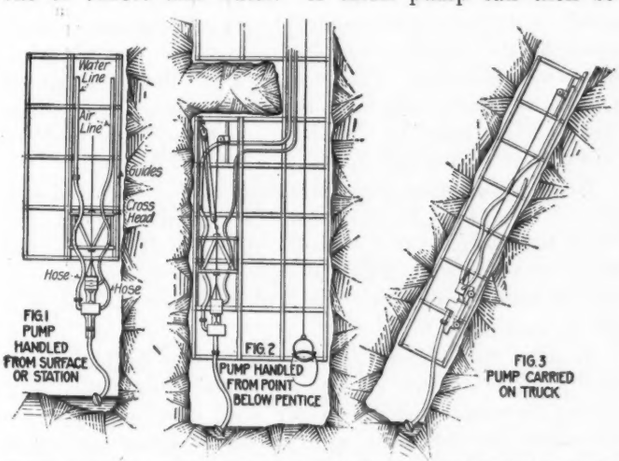
Details of Practical Mining

The Handling of Sinking Pumps

By W. V. De Camp*

In shaft sinking, the sinking pump should be eliminated if possible; from experience gained in sinking several shafts I have reached the conclusion that it is possible to do so in most cases. If there is a tendency for the shaft to make its water directly in the bottom, there is little or no use in trying to avoid using a sinker. If, however, the water is coming from above or if certain strata are known to carry water and to cut the shaft at certain points, it is easy to cut off this water in the shaft where encountered and at least make the use of a sinker intermittent.

With a shaft of sufficient size, a ring dam can be constructed at a point a set or two below where the water enters the shaft, and directly below the same point a small tank placed in one compartment will enable one to collect this water. A small pump can then be



FIGS. 1 TO 3. METHODS OF HANDLING SINKING PUMPS

set up over this and the use of the sinker in the bottom discontinued. If it is not feasible to place a tank in the shaft, a small sump can be cut in one end of the shaft. In this way it is often possible to sink 50 or even a 100 ft. without the use of a sinker. On again encountering water, the tank or sump can be placed at a lower point, another ring dam built, a small pipe run from the upper dam to the lower one and the use of the sinker again discontinued.

If the water seams are too close together to make the foregoing method practical and the use of a sinker is necessary for the entire lift to be sunk, it is a simple matter to equip a shaft so that the time lost in handling the pump is reduced to a minimum. The old and often-used method of placing a pump on one of the lower sets of timbers and then constructing a bulkhead to protect it should be relegated to the past, as well as the often-used method of handling a pump with a set of chain blocks or a block and tackle.

*Mine superintendent, Blue Bell mine, Mayer, Ariz.

The following method has been followed with great success: If no hoist is available to handle the pump from the level above, a small air hoist of the column type can be used; in the event that the small hoist is not strong enough to handle the heavy pump, the hoist may be used to pull the fall line of a set of double or triple steel blocks, to one of which the pump is fastened. In this way a 300-lb. pump can be handled with ease by using a $\frac{5}{16}$-in. steel rope and a set of triple blocks.

Directly above the pump run a short cable connecting the pump hangers to the bottom block. Pass this cable through a crosshead, which crosshead engages guides placed in the compartment. This short cable can be clamped tightly to the crosshead so that the pump and crosshead will move together. The guides can be carried down to the last set or even a set above, which will generally place the pump low enough for good operation. Should the shaft be carried several sets below the timbers, a longer cable can be used and the pump swung a considerable distance below the last set. In this case, however, it becomes necessary to anchor the pump to the sets above with one or two pieces of cable in order to prevent swinging.

Connect the discharge of the pump to a piece of flexible metallic tubing of sufficient diameter, and in turn connect this to the permanently fixed pump column above. This piece of tubing should be at least 20 ft. in length, and even 30 ft. would be better. The air hose to the pump can also be of metallic tubing or ordinary air hose of the same length. I have found metallic tubing much more serviceable than hose, since any rubbing of the hose on the timbers due to vibration will quickly wear it out; in addition, the tubing will withstand much greater pressures than the hose. A bumper placed on the last set will stop the crosshead as it descends with the pump, and since the crosshead and pump are clamped together, all weight is removed from the hoisting cable.

When drilling and loading operations are completed one man can go up to the air hoist and start hoisting the pump, it being only necessary to see that the air and water discharge lines are clear of any projecting timbers. The 30-ft. hose will enable the operator to hoist the pump to a point 40 to 60 ft. from the bottom of the shaft, which is generally sufficient to protect the latter from flying rock. The entire time required to hoist or lower a pump by this method and with the connections and equipment described is not over five minutes, since it is not necessary to connect or disconnect the discharge and air hose.

The type of pump used is very important, as it is often the case that a shaft makes just sufficient water to prohibit bailing, yet hardly enough to keep a sinker in continuous operation. The result is that the pump is handling a larger percentage of sand and mud and, if run slowly, will often stop, causing considerable trouble. For a shaft making a small amount of water, as de-

scribed, I have always used a positive actuated pump, finding that it can be run satisfactorily at a much slower rate than a pump of the tappet-valve type.

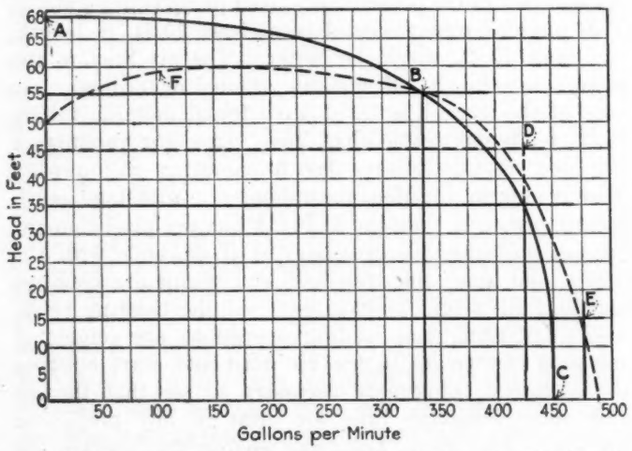
The method described has been used with great success in vertical shafts and has also been applied to inclined shafts by the use of a flat truck on rails, the pump being clamped to the truck. In the accompanying sketches, Fig. 1, shows the application to vertical shafts, Fig. 2, shows the application where there is a timber bulkhead or pentice above and Fig. 3 shows the application to inclined shafts.

Centrifugal Pump Hints

To operate a centrifugal pump so as to get the most work out of it is more of a job than the simplicity of the pump would indicate, says F. Webster in *Power*, May 8, 1917. The machine is capable of producing a lot of surprises. Some of these are its failure to deliver water either against a standpipe head or on open nozzle; it may stop drawing water; a change of head either high or low may give unlooked-for results; it may get hot pumping cold water; the shaft sometimes gets scored in the stuffing-boxes; the motor may get "stuck" when the head is considerably lowered; and a combination of circumstances may operate all at once and effectively give the double-cross to the operator.

The operator has nothing to do with the design of the pump, but if he knows why it is designed so and so, and if he has a copy of its characteristic curve, he will have a wonderful advantage when the pump takes one of its tantrums.

As a general thing the foundation for a centrifugal pump need not be as heavy as that for a direct-acting



CAPACITY CURVE OF CENTRIFUGAL PUMP AT 1000 R.P.M.

steam pump. The suction pipe should be as direct and short as possible and one or two sizes larger than the pump inlet. There should be a foot valve and a strainer at the bottom of the suction pipe, and the free opening through these ought to be from two to four times that of the pipe. The slots through the strainer should be narrower than the smallest passage in the impeller so as to catch materials that might clog the pump. A good style of foot valve is one having a double gate hinged at the sides and opening from the middle. The vacuum gage should be close to the pump inlet, and when the pump is operating properly, this gage will register anywhere from 3 to 7 in. of vacuum. If the strainer clogs or if the water flows faster than about 10 ft. per sec., causing too much air to enter and friction loss, etc., the gage may show 15 in. or more.

The discharge pipe ought to be larger than the pump opening. Install a gate valve and a check valve near the discharge with suitable drains, priming pipes, etc., and a pressure gage. Always close the gate valve before starting and before stopping. All centrifugal pumps must be primed, and this should be done before starting, otherwise there is danger of heating and expanding the impeller and injuring the pump. Do not prime by means of gate valve in the discharge, use a separate system.

One of the most useful possessions of the operator of a centrifugal pump is what is known as the characteristic curves of the pump. This shows the relationship of the capacity, speed and head. Such curves are made by the builders when the pump is tested before shipment, and they are generally furnished on request. A study of these curves will show the operator what to expect, and they will aid him in solving many a mystery. A typical set of curves is shown in the illustration.

Two lines *OA* and *OC* are drawn at right angles, and each is marked off in equal spaces to any convenient scale. The horizontal scale represents gallons per minute delivered by the pump, and the vertical scale gives the head in feet. The pump from which this curve was made was operated by an electric motor at 1000 r.p.m., which is its designed standard speed. The greatest head given by the impeller was 68 ft., and this was when no water was delivered. The greatest water flow, 450 gal. at *C*, was produced when there was no head, the pump outlet being open on the level. At any intermediate point, as at *B*, 330 gal. flowed at a head of 55 feet.

Now suppose that there is a demand for, say, 425 gal. at 45 ft. head. In this case the ordinates from the respective points on the scales meet at *D* outside the characteristic curve *ABC*, showing that the pump will not fill these conditions. Nor will it deliver 475 gal. at a 15-ft. head, as at *E*.

Besides the capacity curve, the pump builders construct curves for the efficiency and the horsepower. The power increases with the water flow, even with a great reduction in the head, and operators often get stuck when attempting to change the head and capacity. When the load on the pump is mainly the weight of the water —that is, the friction is small, as for irrigating, emptying basins, etc.—a very little drop in the speed will stop the flow. On the other hand, if the piping is extra long so as to make a high friction, as in the case of condensers, mining work, etc., a considerable variation may be made in the speed of the motor without stopping the flow.

Sometimes the design of the pump is such that its delivery is very unstable, and if the operator is not posted on its characteristic curve, he may have considerable trouble in getting the work out of the pump. For example, its curve may be like the dotted line *F*. This shows that the head rises from 50 ft. to *F* as the flow increases from zero to 150 or so, or through quite a range, and then diminishes. As the head at starting is only 50 ft., the pump may not be able to start against the head *F* of a filled standpipe without having its speed above the normal.

Another method is the use of a bypass to take off the static head. An unstable pump is liable to stop flowing from either a varying motor speed or head.

Events and Economics of the War

The British and French have made further progress in pushing back the Germans on the Western front. All other fronts have been relatively quiet.

In Washington the conscription bill is still in conference. Important steps have been taken, however, by the officials toward the ship-building program and in organizing the railways. Contracts for munitions and supplies for the army and navy are being let and the immediate organization of nine new regiments of engineers to go to France to attend to the railways has been ordered.

The French commission has been touring in the Middle West and comes to New York today, May 9. The British Commission will come here later in the week.

The Socialists in Russia created a disturbance that looked ominous, but the provisional government rode through the storm and is now declared to have demonstrated its strength. On the whole the outlook in Russia is improved.

The Liberty Loan is progressing satisfactorily.

Engineers First To Go

Nine new regiments of army engineers, to be composed mostly of highly trained railway men, will be the first American troops to be sent to Europe. They will go "at the earliest possible moment," the War Department announced May 7.

The new forces will be volunteers, raised at the nine great railway centers of the country. Each regiment will be commanded by an engineer colonel of the regular army, aided by an adjutant who will also be assigned from the regular army.

The War Department has sent out orders for raising as rapidly as possible nine additional regiments of engineers, which are destined to proceed to France at the earliest possible moment for work on the lines of communication. These regiments will have as their central recruiting points the following cities: New York, St. Louis, Chicago, Boston, Pittsburgh, Detroit, Atlanta, San Francisco and Philadelphia.

The nine regiments first to go to France will be organized under the national defence act, which allows the President in time of emergency to call for the formation of special units.

Recruiting for the regiments and the organization of each force will be directly under the colonel of each regiment. Recruiting machinery of the regular service or the National Guard will be placed at their service and it is hoped the enrollment of the troops will take little time. The decision to send the engineers is understood to have grown out of conferences here between Government officials and members of the French and British war missions. One of the greatest problems of the war has been that of maintaining adequate supply lines.

The Military Engineering Committee of New York, in the membership of which all the national engineering societies are represented, with headquarters at 29 West 39th St., has been active in the preparatory work of organizing a unit. Announcement to this effect was made by the committee last night through J. Waldo Smith, its chairman.

In designating the character of men needed Mr. Smith issued a statement citing the following classes and the number of men for each that are to be recruited:

Enginemen, firemen and dinkey skinners (locomotive), 48; firemen and walking bosses, 60; enginemen (stationary), 24; oilers, 18; machinists, 60; yardmasters, 12; trackmen, 120; dock builders and bridge carpenters, 60; horseshoers, 6; electricians, 24; bridgemen and bridge builders (steel), 60; pipefitters, 24; handy men, 12; telegraphers, 12; brakemen, 24; riggers, 36; draftsmen, 12; surveyors, 24; car repairers, 24; clerks, 12; storekeepers, 18; carpenters, 60; masons, 18; pile-driver men, 24; linemen, 42; plumbers, 12; farriers, 6; gas engine men, 12; cooks, 24; stenographers, 12; superintendents, 16; blacksmiths, 24; powder men, 24; drill runners and helpers, 36.

In addition to these a certain number of able bodied workmen and men experienced in construction will be selected.

Organizing the Railroads

An appeal to the railroads to "show what they can do for their country" by instituting operating reforms and economies during the war was issued May 4 by the National Defence Council's general railroad board.

Conservation of motive power is recommended by reducing the number of locomotives ordinarily under repair from the average of 15% to 10%, which would be equivalent to adding 3325 to the number in service; increasing the average miles per day of a locomotive from 75 to 90 by quick turning at terminals, double crewing or pooling, which would have the effect of adding 13,300 locomotives, and by giving close attention to boiler repairs and firing methods, which would enable each locomotive to haul from 20% to 30% more freight.

Increased car efficiency can be obtained, it is pointed out, by quicker terminal handling, prompter loading and unloading, by loading each car 10% in excess of its marked weight capacity and by reducing to 4% the average number under repair, releasing 64,000 cars for active service. Quicker movement, it is estimated, would release 515,000 cars and heavier average loading 200,000.

Railroad men have felt for a long time that economy demanded a reduction in passenger train schedules, especially where two cities are served by competing roads, each of which generally gives sufficient service to care for all the traffic. Coal consumption would be greatly reduced, operating problems simplified by reducing the number of trains and delays to freight movement materially lessened.

Motive power and equipment thus released would not be available for service abroad, it was said, because American locomotives are too heavy for use on foreign lines, and besides are badly needed to move traffic in this coun-

try. It is suggested, however, that there are in existence here several thousand locomotives which have become obsolete through the adoption of heavier models, but which would be extremely useful on the French or Russian lines with their moderate grades and curves. These engines have been stored away, with the exception of a few sold to lumber companies, and their removal from the country would have no effect on the ability of the railroads to care for traffic.

The commission headed by John F. Stevens, whose appointment was announced May 4, will enlist a number of trainmen, yardmen and practical transportation experts, who are expected to take the first steps toward clearing up the congestion on the Trans-Siberian and other Russian lines which are now said to be in such a state that movement of supplies in any considerable quantities is practically impossible.

"There will be more war-time railroad business than the lines can handle," said Daniel Willard, May 3. "The country's systems are hauling more freight than ever before, but they cannot carry all that is in sight and it will be necessary for the General Railroad Board to decide which classes of freight shall have preference. Already the Board has said coal must go first and we are filling the country's coal yards for next winter. What is the next most important commodity remains to be decided. The Agriculture Department asked that seeds and agricultural implements be moved and they too are being given preference.

"I shall give you an instance of what we have accomplished in economy of transportation. Heretofore the railway lines have taken coal from the East to the Pacific Coast in steel cars and returned the cars empty. The railroad Board has ordered to shippers to put their coal in box cars and these cars are now being returned loaded with freight. It caused some inconvenience in unloading, but everybody concerned agreed to accept the change.

"We are now rushing coal from the central fields to the Northwest by way of the Great Lakes and all other freight goes behind the coal. I can say I believe this means there will be no coal shortage in that region."

Goethals to Rush Wooden Vessels

Official announcement was made May 7 that the Government will build wooden ships and that Gen. Goethals will sign contracts for them as soon as the shipping bill becomes a law. William Denman, chairman of the Shipping Board, authorized the following statement:

"The wooden ship scheme being definitely under way and satisfactorily progressing, the board and Gen. Goethals have turned to the stimulation of steel ship building. Undoubtedly the stories concerning the abandonment of the wooden ship plan arose from the fact that having nothing more to say about the wooden ships we have talked nothing but steel.

"The wooden ship plan will be carried on as originally conceived. The board never at any time has given out a statement in which it anticipated the number of wooden ships it would be possible to build. It is confidently expected, however, that in eighteen months there will be turned out an enormous wooden tonnage. We hope in the same period to turn out an even larger steel tonnage.

Revolutionary changes in the method of building steel ships are likely to be one result of the campaign this country is about to start with the object of putting ships afloat faster than the German submarines can sink them. The plan is to utilize in the construction of steel ships the American methods and engineering genius which has made the steel skyscraper the distinctive building of this country.

The characteristic method of building a skyscraper if followed in the case of a ship, it is held, would reduce the time of construction. In other words, building ships by the skyscraper methods should enable this country to turn out many more steel ships than would be possible under the plan now followed, not only because it would reduce the labor required at the shipyards, but also it would permit fabricating plants of the country to devote their energies to ship construction.

Chairman Denman of the Shipping Board described as the purpose of the board the formation of an enormous fleet of vessels under the American flag with the least possible delay. Wooden and steel ships now building will be taken over by the Government by arrangement with their owners. In four or five months the first of the wooden ships of the board's emergency tonnage plan will be launched, but it will be six months, in the opinion of shipbuilding experts, before the delivery of these ships will become regular.

Navigation laws may be modified so that American merchant marine may operate unhampered by restrictions which would impair efficiency. This is now being considered by the shipping board. It is believed the La Follette seamen's act will be altered to permit manning American vessels by crews which do not now come under its provisions.

At present crews of American ships must be composed of men of whom 75% speak English. The shipping board undoubtedly will eliminate this provision during the war. It is expected that the President will be empowered to modify any measure which in the judgment of shipping experts, now checks efficiency.

The Prospect for Business

A tangible idea of the governmental attitude toward war purchases and an indication of the probable fairness of its buying policy is contained in the announcement of zinc prices to be paid. These represent virtually present market quotations, are plainly equitable, and ought to be indication enough of the Government's good faith and intention to pay for what it gets. The establishment of a centralized buying bureau for the Allies, moreover, is planned more to prevent competitive bidding for supplies on the part of the Allies than to enforce a price level far below the market.

When the huge government expenditures become better diffused and some approach to the normal is made in manufacturing and shipping schedules a new prosperity should develop, says the *Boston News Bureau.* It may be of a different character from that of the past two years, but it will be there. And the masses are likely to share in it to a greater degree than before. If England's experience is any criterion the likelihood is that labor will be prosperous beyond all previous experience. The menace in England has been the wrong diversion of its savings to dissipation and luxurious living. The shortage of labor in this country alone would seem to be sufficient to

buoy up or to elevate further the wage scale. A widespread prosperity among the masses is the best guarantee possible for the continuation of a high purchasing power for the country.

The *World* says that the United States is to create a board of supplies, which will prevent competitive bidding between European nations for war materials and food supplies that in past have resulted in payment of all sorts of prices. The Government does not propose to insist that supplies be furnished to foreign governments at prices it will pay producers, but there will be one price for the same article to all Entente nations. The board also will fix a uniform rate to cover railway and marine transportation in addition to arranging for scheme of expediting transportation.

War as An Economic Leveller

Normal business conditions proved impossible in England after her entry into the war, Lord Eustace Percy, British trade expert, said on May 5, discussing the economic upheaval that hostilities had brought to that country. Industry, he said, could not keep going as in peace times, owing to a fundamental change in demand, but the immediate dislocation of labor that followed proved not serious, as it was all shortly absorbed into other lines of work built up by war needs.

The war had proved for England, he said, a great economic leveller. The essential restrictions operated about equally on rich and poor. The rich, however, lost a large part of their wealth by income taxes running as high as 33⅓%, while the poor showed unusual prosperity, because of increased wages, large separation allowances, and the influx of about 800,000 women of the lower classes into industry.

Lord Eustace said England not only found business as usual impossible, but also that a great restriction in output soon resulted. The foreign trade, he said, had been clung to desperately at first, not only because of expected conditions after the war, but also to keep up exchange. It developed shortly, however, that considerable trade had to be given up, owing to pressure of munition needs. Then effort was centered on maintaining the so-called reserved occupations possessing military importance. To do this it was necessary to withdraw from the front many men who had volunteered at first, and to exempt many others who were later conscripted.

Lord Eustace said there had been extraordinary little friction with labor, because most of the restrictions had been voluntarily adopted by labor.

Hoover Arrives

Herbert C. Hoover arrived in New York on May 3 and proceeded immediately to Washington. He declared that the German submarine menace had increased alarmingly in the last eight weeks, and had created a grave situation in Belgium and northern France, where the mortality among the people in the industrial districts was increasing because of the reduced rations.

Mr. Hoover was met at the pier by Baron Cartier, Belgian Minister to the United States, who said he had come from Washington to express his "thanks and reverence" for the Belgian Relief Commission's accomplishments.

"Like every good American, I have come over to do my share," Mr. Hoover said to those who talked with him. "My new duty is too big a proposition to discuss at this time.

"The food situation in Belgium and Northern France requires every effort we can make. At present it is one of extreme gravity because of the submarine boat menace, which has increased alarmingly during the past eight weeks. Wheat and corn are needed badly, and also pork and beef.

"The Belgian Relief Commission by Mar. 1 had struggled to its feet again after receiving the knock-out blow of the submarine decree of Feb. 1. Since Mar. 1 we have lost five loaded boats, but in March and April 60,000 tons of foodstuffs were landed. But this 60,000 was 220,000 tons less than we actually required. Because of the shortage the mortality in industrial districts multiplied by three. The children, however, did not suffer. They are always looked after first. At this time we have only thirty boats. We need seventy.

"I am going to Washington immediately to make my report to the President regarding conditions as I left them in Europe. I am not now at liberty to discuss the measures that the United States will take in conserving her own food resources and in furnishing the Allies with vast quantities of edibles. What the Allies need is wheat and corn, but they also need meats. America will have to exert her most supreme effort to handle the food situation in Europe. The Belgian Commission now has thirty boats, but its work requires seventy boats. Spain and Holland are doing admirable work in the distribution of food, and it is up to us to supply this food and the ships to carry it."

Composition of the New Army

We are able to give for the first time, says the *Army and Navy Journal*, May 5, the tentative plan drawn up by the Army War College and submitted to the General Staff, dealing with the composition of the army to be developed from the first 500,000 men called by the President under the selective draft provisions of the new army bill. The plan provides for the following divisions:

16 Infantry divisions; each 913 officers and 27,243 men.
16 Divisional hospitals; each 24 officers and 222 men.
64 Camp infirmaries; each . . . officers and 2 men.
2 Cavalry divisions; each 607 officers and 16,021 men.
2 Divisional hospitals; each 24 officers and 238 men.
6 Camp infirmaries; each officers and 2 men.
Medical corps (total) 288 officers and 1,000 men.
Coast artillery corps, (total) 666 officers and 20,000 men.

ARMY CORPS TROOPS

16 Brigades field art. (heavy); each 48 officers and 1,319 men.
8 Aero squadrons; each 10 officers and 154 men.
8 Balloon companies; each 19 officers and 154 men.
10 Field hospitals; each 6 officers and 73 men.
10 Ambulance companies; each 5 officers and 150 men.
22 Field bakeries; each 1 officer and 67 men.
6 Telephone battalions; each 10 officers and 215 men.
16 Pack companies; each . . . officers and 14 men.
6 Ammunition trains; each 4 officers and 852 men.
6 Supply trains; each 2 officers and 426 men.
Grand total, all units, 18,538 officers; 528,659 men.

The officers for this force will be drawn from the Regular Army and the National Guard, the Officers' Reserve Corps and "the country at large." The War College recommended that 200,000 men be withdrawn from the Army and Guard (when both are recruited to full authorized strength) for appointment as company officers and noncommissioned officers in the new army. The college advised against any estimate which would give less than 150,000 men from this source.

It is the specific purpose of the War Department that each regiment in the new forces shall be commanded by an officer from the regular establishment, and that at least one of his majors and all of the staff officers (adjutant, ordnance, supply officer, etc.) shall be experienced men from the Regular Army.

Hoover on Food Cohtrol

Important changes are likely to be made in the pending legislation designed to give President Wilson drastic powers for the control of the nation's food supply as the result of testimony given by Herbert C. Hoover before the House Committee on Agriculture on May 8. Mr. Hoover strongly recommended the creation of a Board of Food Control to be wholly apart from present government employment, and to be drawn from business men. This recommendation is regarded with great favor by many members of the Committee on Agriculture, and its adoption is expected.

Mr. Hoover also spoke briefly concerning the use that should be made of cereals and the proportion that should be used in producing alcohol. Members of the Committee on Agriculture said after hearing Mr. Hoover that they were very favorably impressed with his recommendation for separating the question of controlling the sale, distribution and price fixing from present government departments.

Appointment of Coal Committee

F. S. Peabody has been named to head a national committee on coal production which will work to increase the mining output and facilitate distribution. The new committee has been established by the Council of National Defence and will comprise 15 experts. Sub-committees to deal directly with producers and distributors will be appointed throughout the country.

"It is clear there must be a tremendous increase in production at the mines," said Mr. Gifford, director of the Defence Council: "that there must be no interruption of any mines; that there must be improved freight facilities. The committee will coöperate with the mine owners and the labor committee in minimizing the danger of strikes and in bringing about conciliation and mediation. It will assist the transportation committee in making available more cars and in giving coal cars a clear track.

"Coöperation with concerns engaged on government work and in immediate need of coal will be an important branch of the committee work."

Aëroplanes to Destroy Submarines

Charles M. Manly, consulting engineers of the Curtiss Aëroplane Co., addressed the Engineering Society of Buffalo, Apr. 19, on aëroplanes for the destruction of submarines. According to the *Journal* of the American Society of Mechanical Engineers, he said that in the immediate future there will be very important developments in flying boats. The answer to the submarine will be the flying boat large enough to carry a gun of sufficient caliber to sink a submarine when the latter is submerged or when nothing but its periscope is showing. Such a flying boat might also readily be equipped with torpedoes and tubes for launching them so that it could fight the submarine with its own weapon or it could be used against commerce raiders.

The largest flying machines will be of the marine type, and machines several times the size of any so far made will be seen eventually. The Curtiss flying whale now being tested by the United States Navy in Florida has an upper wing spread of more than 90 ft., is driven by two 200-hp. motors and has a boat 46 ft. long, weighing with fuel and pilot more than 5500 pounds.

The Liberty Loan

Secretary McAdoo announced on May 3 that the first issue of the "liberty loan of 1917 would be $2,000,000,000." Subscriptions may be made now by all who are ready to buy these bonds, and they will be received until June 15. The Secretary issued the following statement:

I have determined to make an initial offering of $2,000,000,000 of the 3½% "liberty loan of 1917." The bonds will be dated July 1, 1917, with interest payable semi-annually Jan. 1 and July 1. The maturities will be anounced later. In accordance with the provisions of the act, the bonds will be convertable into bonds bearing a higher rate of interest than 3½% if any subsequent series of bonds shall be issued at a higher rate of interest before the termination of the war between the United States and the German Government.

The "liberty loan" will be offered at par as a popular subscription, and ample opportunity will be given to every man and woman in the United States who wishes to subscribe to secure an absolutely safe investment, free from Federal, state, or local taxation (except, of course, inheritance taxes). The bonds will be in such denominations as will put them within the reach of every investor. Details as to denominations, redemptions, etc., have not been fully worked out, but announcement will be made in due season.

Subscriptions will be received until June 15, 1917. The bonds will be ready for delivery July 1. Allotments will be made as rapidly after June 15 as possible. The details as to manner of payment for the bonds will be announced later. It is sufficient to say at the moment that payments will be arranged in such a way as not to cause inconvenience or disturbance. Since the great bulk of the credits to be established for the foreign governments is required for purchases made in this country, the operation will be largely a transfer, or exchange, of credits, and should have a stimulating and helpful effect upon the general business and financial situation.

The initial issue has been determined by the essential requirements of our own Government for the conduct of the war and necessities of the foreign governments to which credit is being extended under the provisions of the act approved Apr. 24, 1917. After having received advice and suggestions from bankers, investment houses, business men, and investors in all parts of the country, I feel confident of the ability of the market to absorb rapidly and readily the $2,000,000,000 offering. From communnications I have received from every part of the country, large over-subscription to the issue seems beyond doubt.

This is the largest single piece of financing ever undertaken by the Government of the United States, and in order that ample opportunity may be given every one to subscribe, I have decided to use the 12 Federal Reserve

Banks, which are fiscal agencies of the Government, as the central agency in each of the 12 Federal Reserve districts for receiving the subscriptions, for taking care of the details of deliveries of the bonds after allotment, and for handling the payments of subscriptions in such manner as will best serve the general business and financial situation. The Federal Reserve banks are admirably equipped for this service. All banks, national and state, trust companies, private bankers, and bond houses will be authorized to receive subscriptions. While the subscriptions will be addressed to the Secretary of the Treasury, and will be direct subscriptions to the Government, it is desired that they should be forwarded through the Federal Reserve banks of the respective districts, which, in turn, will be prepared to supply full information, and, because of their close touch with banks, bankers, and investors in each district, will be able to facilitate very greatly the work in hand.

While this work is being done by the Federal Reserve banks and the bankers and business men, the general direction and supervision of the entire operation will be maintained at Washington. Agencies outside of the banks themselves, such, for instance, as post offices, express companies, department stores, newspapers, and other volunteers who have come forward in great numbers in the most patriotic and generous spirit to offer their service and facilities to the Government, will be employed and brought into coöperation with the general plan.

The greatest immediate service the American people can render in this war for universal liberty throughout the world is to furnish the means for its vigorous prosecution. This bond issue is the first step. I earnestly bespeak the coöperation of every citizen throughout the length and breadth of the land in this great service of patriotism.

Engineering Commission to Russia

Expert engineers to help Russia organize and construct additional railroad lines will be sent from this country in the near future. The commission will be headed by John F. Stevens. With him will be John E. Greiner formerly of the Baltimore and Ohio R.R.; Henry Miller, once president of the Wabash; N. L. Darling, of the Northern Pacific, and George Gibbs, of the Pennsylvania. Stanley Washburn, a newspaper man who has recently been in Russia, is attached to the commission also.

These men upon reaching Russia will ascertain the needs of that government as to cars, engines and rails. There has been a terrific strain on cars, owing to the hard usage and lack of oils and grease.

Raise Potatoes and Help Win the War

Under the above caption the Pennsylvania Railroad Co. has issued a small book which is an abridged edition of Bulletin No. 190, Department of Agriculture, Commonwealth of Pennsylvania, which in handy convenient size, embellished with the United States flag and the red seal of the system, takes up the matter of potato culture and tells in detail how, when, where and what to plant, together with instructions for cultivating, spraying, harvesting, storing and marketing the crops. Copies of this valuable little book may be obtained free from any station agent or division freight agent of the Pennsylvania Railroad Co., or the freight traffic department, Broad St., Philadelphia. We recommend it to the many mining camp gardeners who are going to plant extra ground and cultivate intensively during the war.

Governor Brumbaugh of Pennsylvania has sent out an appeal to consumers of potatoes to save the parings so that eyes may be used for seed.

"I recognize the fact," the Governor said, "that the mere paring of a potato will not produce results at all adequate to the productiveness of the soil where such parings are placed, but I wish hotel and restaurant people and others would have the eyes of the potato cut deep enough to give sufficient nourishment to the eye in its creative period, and then through the members of the local public safety committee have these parings distributed to the people who need them and who have been unable to secure seed by reason of its scarcity and its high price.

"This applies particularly to the large mine regions, where a great many of our miners in patriotic endeavor have prepared soil and have not been able to procure seed."

Notes of Interest

A correspondent to the Boston *Globe,* after a trip to French naval bases declares that French territorial waters in the Mediterranean are wholly cleansed of submarine peril, hydro-aëroplanes discovering U-boats almost as surely as army aviators spot batteries.

According to Howard Coffin, the British at times have had as many as 1000 aëroplanes in the air on a single front and have kept behind the lines 15,000 to 20,000 more machines than the Germans possessed.

President Shedd of Marshall Field & Co. says: "Beyond unusual care with regard to those commodities in which there is shortage, such as foodstuffs, extraordinary economy is unwarranted. Business must go on in the usual way. It is to be hoped that the best judgment of the country will be sought in order that no undue burdens that would throttle business shall be imposed."

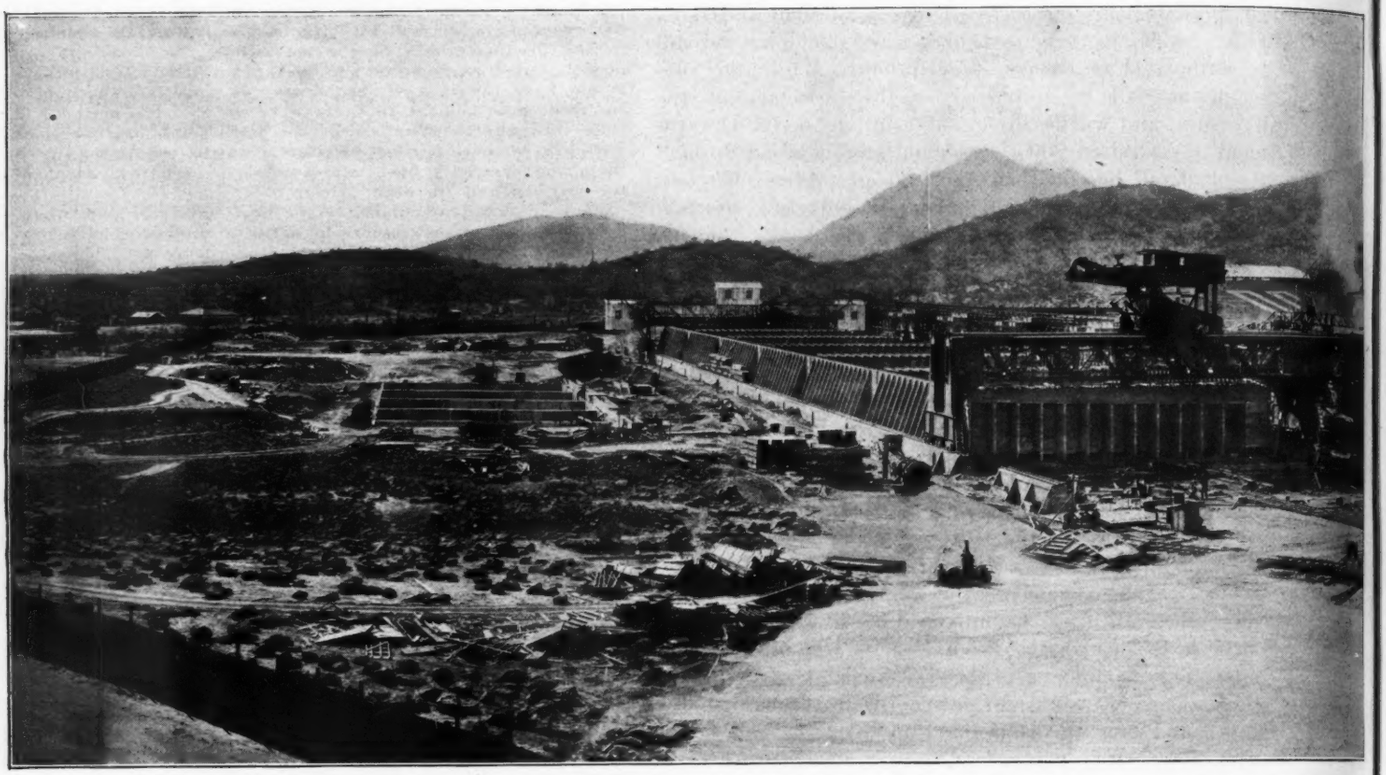
It is said that there was a field gun, exclusive of heavy types, for every 20 yards on the entire 40 miles of Somme battle front, or say 3500 field pieces, firing 145 shells each per day, or a total of 15,732,500 in the month of July, 1916. One field battery of howitzers (six pieces) fired 3500 gas shells in a single day.

The Belgian government understands that the United States will devote $90,000,000 to provisioning the population of Belgium and $60,000,000 to northern France. Relief work now costs $7,000,000 a month.

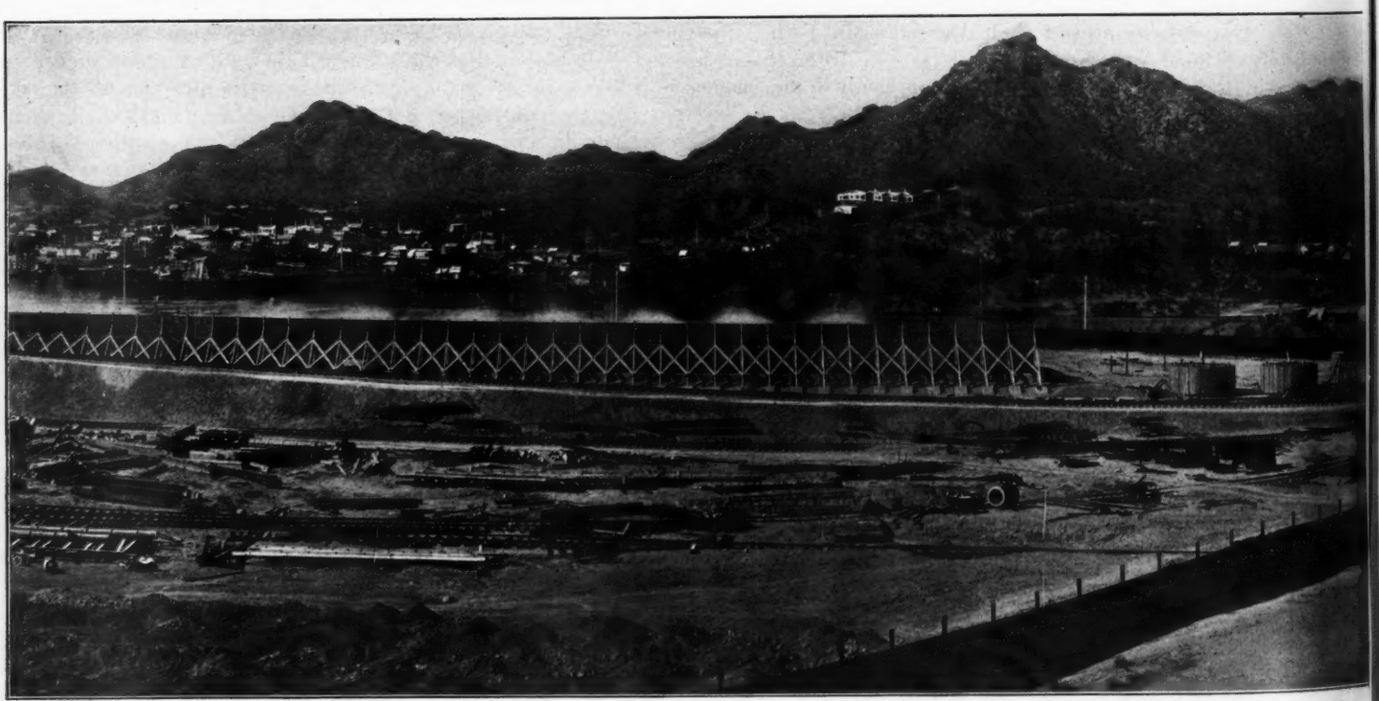
Washington says plans are being perfected for mobilization of idle youth of the country for use in agriculture and other industries vital to national defence. There are 5,000,000 boys between 16 and age of enlistment. Estimated that 2,000,000 are permanently idle. Number is larger in summer.

Lord Rhondda says that American business has nothing to fear from the war. Profits in England have been above normal since war began. The British government realized $700,000,000 from excess profits tax last year. Profits were $1,160,000,000, the taxation on which was 60%.

New Cornelia Copper Company's

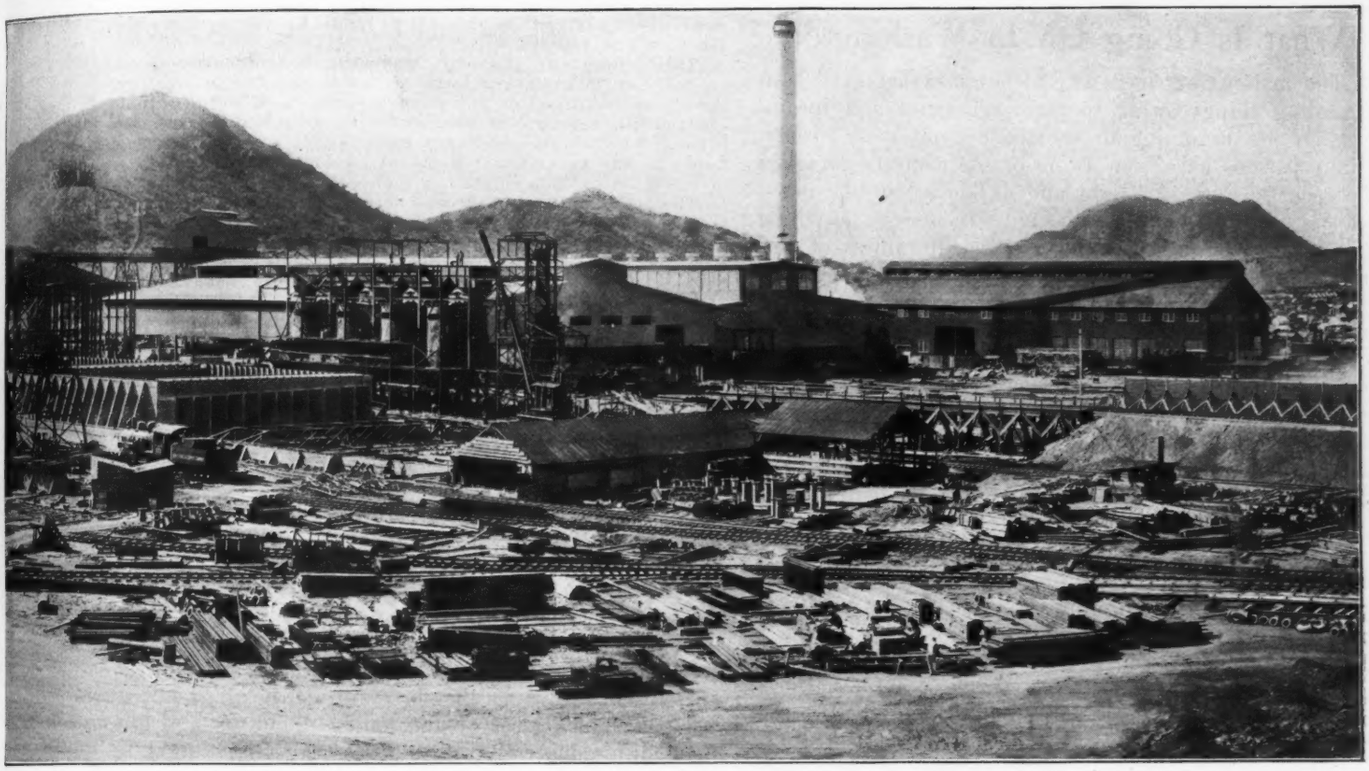


NEW CORNELIA'S COPPER LEACHING TANKS, WITH HULETT UNLOADER, THE ROASTER BUILDING, CELL

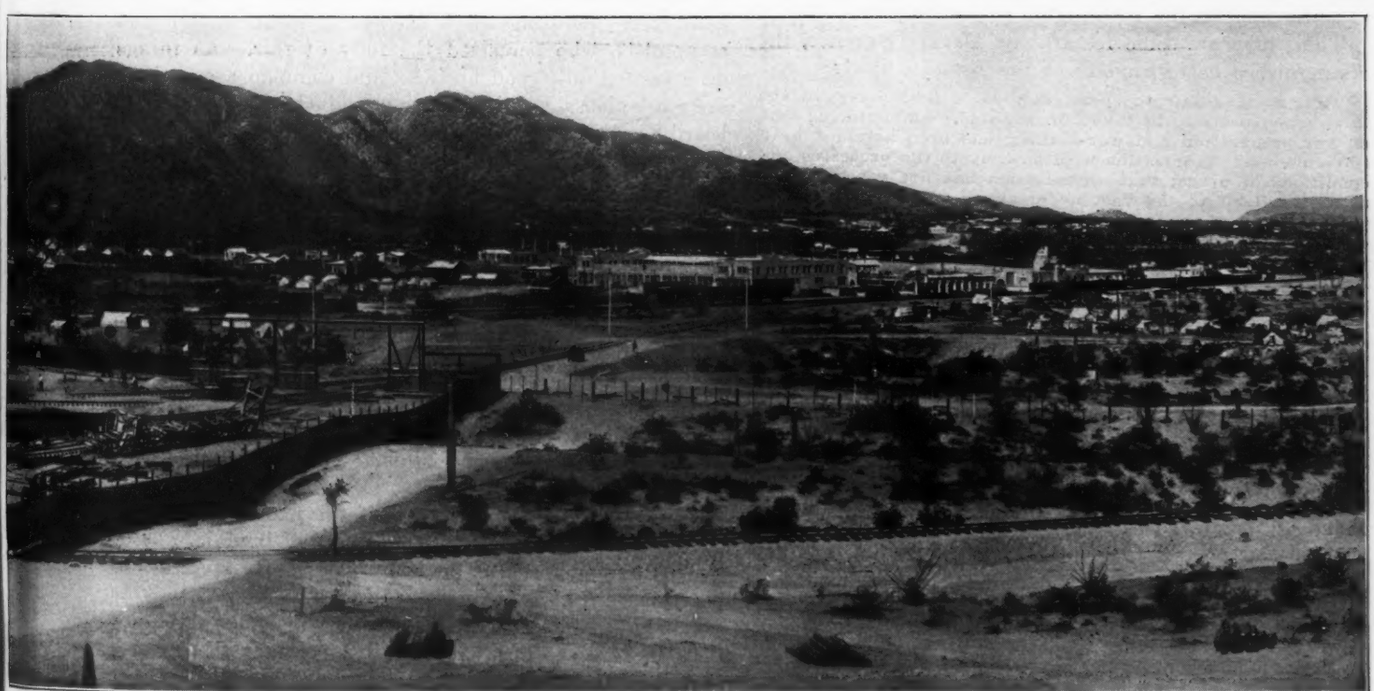


CONTINUING THE ABOVE PANORAMA, ARE SHOWN THE COOLING POND AND, IN THE BACKGROUND, THE NEW MODEL TOWN

5000-Ton Leaching Plant, Ajo, Ariz.



BUILDING, POWER HOUSE AND MECHANICAL SHOPS. LEACHING OPERATIONS BEGUN LAST WEEK IN APRIL



COMMUNITIES THAT HAVE GROWN UP AROUND THE NEW CORNELIA OPERATION, AND ON THE RIGHT, THE THAT IS BEING BUILT

Editorials

What Is Going On In Washington

The malign influences in Washington that have been retarding things owing to their ignorance and incompetency are beginning to be talked about more openly. Many persons have been aware of the contests going on between the forces of light and darkness, but the newspapers have had but little to say of it, scarcely anything but hints. On the one hand has been the influx of new men, led by the Advisory Council for National Defense, men fresh from big affairs in which they have made great names, anxious now to give to the Government the benefit of the talent and experience that made them successful. On the other hand is the bureaucracy accustomed only to the leisurely muddling with routine business, overwhelmed by the great things suddenly thrust upon it, unable to handle them but unwilling to sacrifice their fancied prestige by letting others take anything off their hands. The trouble has been that the newcomers have had only advisory functions. The actual doing of things still focuses in the bureaus. The advisors have chafed while work piled upon desks in the bureaus awaiting the orders to move. This has not been universally the case. There have been Cabinet ministers and bureau chiefs who have generously and wishfully joined hands with the business men, but even they have cumbered themselves with details that they ought to have brushed aside. On the other hand, there has been actual friction in some cases between the bureau chiefs, nay even department heads, and the men of business. Some of this is now beginning to be revealed by the Washington correspondents.

Thus, here are some remarks by David Lawrence, the distinguished correspondent of the *Evening Post:*

It is most unfair to speak now as if inefficiency in the Government were to be taken for granted. An enormous task of war preparation and war-making has been assumed by a Governmental organization used entirely to the processes and conditions of peace; that organization has not yet had time to adjust itself to the vast undertaking. It is true that at present many of the Government departments are working at cross purposes; that many bureaus are assuming powers which they never were intended to have; that the Council of National Defense is not altogether in sympathy with some members of the Cabinet and an open break is spoken of as one of the possibilities of the future, and that a general housecleaning may be compelled if public opinion in the United States is permitted to learn the true situation.

Within a day or two the *Sun* came out with the following report:

An acute divergence of opinion has arisen between the Secretary of the Navy and the newly created munitions board over war supplies. This has already resulted in the munitions board taking the question of controlling prices out of the hands of the Navy Department. Hereafter business firms engaged in war supplies, including particularly steel manufactures, need not fear they will be forced to accept such prices as Secretary Daniels stipulates under threat of Government control of plants.

The question came to an issue over 400,000 tons of steel plates for which Secretary Daniels had asked bids. The bids he regarded as too high, and the position taken by the Secretary was one of suspicion toward the bidders. His openly expressed conviction was that "the Government was being taken advantage of in this big transaction." Mr. Daniels accordingly said that 2.9c. per lb. was the price the Government would pay, and he asserted he would be able to place his order at that amount.

The bidders said this price was virtually ruinousness and appealed to the munitions board to decide on a fair price. The munitions board, after thorough investigation, decided that Mr. Daniels' estimate of 2.9c. was not fair and regulated the price at 3.5c. per lb. Secretary Daniels protested against this figure on the ground that it meant an additional expenditure of $4,800,000 for this single contract.

The board replied that it was better to give the contractors a fair and reasonable profit than to take advantage by threatened seizure of property or other form of coercion of the situation and drive a bargain which would injure important business interests and in the end prove to the disadvantage of the Government.

On the question of bids for shells the same problem was faced by the munitions board and Secretary Daniels. The board decided in this case, too, that Mr. Daniels was not giving the manufacturers a fair and reasonable price, and the price stipulated by the board prevailed despite protest from the Secretary of the Navy.

The board's motto is that things must be done in a broad businesslike way with an eye for ultimate good to the country and not with a view to saving money for the Government at the cost of damaging legitimate business.

In the above there may be read between the lines other things relating to the controversy that has been going on with respect to one important matter; namely, the purchase of raw material. While this has been going on, action was delayed with the result of generally upsetting the markets, owing to the very uncertainty of things. There were operating the forces of the small intellects that entertained ideas of dragooning producers into giving their products at ruinous prices so that it might be shown to the ignorant public that the ministries were *saving* millions of dollars, with threats to the producers of commandeering if they did not submit. On the other hand were operating the influences of business men and economists, who perceived the folly of this. As things have turned out, good business and common sense (they are much the same thing) have prevailed. The munitions board has apparently obtained some real authority. However, the things related herein are merely some phases of the broad questions that are likely to require some housecleaning in Washington.

Zinc Producers to the Government

The zinc producers of the United States have offered to supply the U. S. Government with the spelter needed during the war at the prices of 11½c. for high-grade, 11c. for intermediate, and 9c. for Prime Western, these prices being based on New York delivery with freight allowances when required at other points. The price for Prime Western, which is equivalent to about 8.80c. St. Louis, is guaranteed against decline, i.e., if the market price falls off the Government will get the benefit of it.

This arrangement as made by the zinc producers and the Government is eminently fair. The differential between high-grade and Prime Western is somewhat lower than the average of what prevailed previous to the war. However, the differential in favor of intermediate (as compared with Prime Western) is somewhat higher. As to the price for Prime Western itself, the quantitative

average for the 10 years ending with 1916 was about 8½c. St. Louis. This was, of course, considerably higher than the arithmetic average for the same years, owing to the greatly expanded sales in 1915 and 1916 at greatly elevated prices, zinc being the first of the major metals to rise to extravagant figures.

Any comparison with 10-year averages is, however, of no use except to furnish a basis for ideas. There is no particular sanctity about a 10-year average, a 20-year average, or any other average, either arithmetic or quantitative, and certainly no reason why any such figure should arbitrarily be selected as a price. The real consideration is what is the economic level? What price will produce all the zinc that is needed?

At the present time, with the inflated prices prevailing for labor and material of all kinds, there is not much doubt that a determining price for zinc is in the neighborhood of 8½c., St. Louis, so long as the present supply is required. At that level the sheet-ground mines of the Carterville-Webb City district of the Joplin region cease to be profitable, or are so slightly profitable that there is but little incentive to operate them at maximum capacity. So long, therefore, as the zinc from them is needed, the price for the metal must be at least 8½c. St. Louis, all other conditions remaining as at present. When their zinc is no longer needed, they being the principal high cost producers, the price for zinc will go below 8½c. and those mines will have to be closed and will remain closed until reductions in the wages for labor, the cost of material, etc., permit them to be operated again.

At the present time about all the zinc that is being produced in the United States is needed, or probably is going to be needed. When, therefore, the zinc producers agree with the Government upon a price that will maintain the supply, without yielding an abnormal profit, both parties to the transaction are conforming to the precepts of sound economics.

The Liberty Loan

The great bond issue is going like hot cakes. We knew it would be so. It is drawing money from the hoards of the people, timid and inexperienced, who have not ventured to put their savings into business or into the investments courted by those who have learned to invest, recognizing the risks. There is no risk in lending to Uncle Sam, and his nephews and nieces are right in dumping the contents of their purses and their stockings into his treasury. Let the good work keep on. Let there be no need for investors in railway and industrial stocks and bonds to sell out their present holdings in order to find money for the Government loan. Any such liquidation would tend to derange business, which is to be avoided.

The drawing of hundreds of millions of dollars from the hoards will mobilize the inert resources and tend to improve business. It will give a lot of people interest on money that heretofore has been lying idle. It will teach them the principles of investment, which also will be good for them. And it will make Uncle Sam very glad if the loan he is asking be offered two or three times over.

To those who have no money saved, wherewith to subscribe, do not let that deter you from being patriotic. Go to your employer and ask him to stake you, promising to pay him in installments as you earn the money. That will encourage you to be thrifty. It will lead you to think of the foolish, expensive things you can cut out of your daily life. It will start you on the road of accumulation which otherwise you might have passed by, considering it too tedious. Well it may be, but now it is patriotic, and anyhow you will be glad if you try it.

Subscribe to the Liberty Loan and do it now!

Mining Profit Taxes

The matter of taxation as it affects the copper producing companies, is now receiving earnest attention. The Hayden, Stone & Jackling companies have adopted the policy of setting aside quarterly the sums that they figure that they will have to pay according to existing laws. Thus the Utah Copper Co. for the first quarter of 1917 set aside $1,280,000, equivalent to 3.142c. per pound of copper produced. Nevada Consolidated in its report for the first quarter of 1917 said, "There is included in operating expenses for the quarter $123,894, which represents accrued county, state, state bullion and federal income taxes. According to our understanding of the excess profits tax law, which went into effect on Jan. 1, 1917, this quarter's proportion of such tax would amount to an additional $112,000, and during quarters in which normal production is maintained, this latter tax will exceed all other taxes combined and have the effect of increasing our taxation more than 100%."

It would be interesting to know just what is the understanding of the Nevada Consolidated people as to how the excess profits tax is to be figured in the case of mining companies, their own included. Nobody, not even the tax collectors, appear to have any clear ideas about this. The Nevada Consolidated people say: "The statement of earnings for the quarter does not take into account the amount accrued for excess profits tax for the reason that the ruling as to how the tax is to be calculated has not been issued, and also because it appears possible that some change in the law may be made before the end of year." The Utah management gives no intimation respecting its understanding of the matter. It is going to be an elegant tangle.

The Anaconda Report

The report of the Anaconda Copper Mining Co. for 1916 is an exhibition of one of the most wonderful performances ever made by a mining company. A profit for the year of $50,828,372 after writing off $7,113,463 for depreciation and obsolescence of plants, and a surplus of $48,395,862 remaining at the end of the year after the payment of $17,484,375 in dividends are financial achievements that are not often recorded.

There is in the report of this company food for analysis and study of great interest, but it must be done with more leisure than is available this week. We may, however, call attention to two things, one of which has been noticed in the financial papers, the other of which has not been. The first of these pertains to the change in the method of bookkeeping. Heretofore the company has reckoned its profits on the basis of its deliveries to customers, i.e., the returns for 1915, for example, comprised copper produced and shipped in 1914 but not delivered to the buyers until 1915, while the product in process and on hand at the end of the year was carried forward at cost. The more

general practice among the large copper producing companies has been to base their reports upon the copper produced and sold during the year. Anaconda has changed its practice of book-keeping to conform to the latter method which swells its profit for 1916 by about $7,000,000. The profit was made—there is no illusion about that—but if the change in the method of book-keeping had been made a year previously the profit for 1915 would have been larger and that for 1916 smaller than now appears. Stockholders will not be disturbed by this matter of book-keeping, which is explicitly referrred to in the president's report.

The other matter of special interest in the accounts is the writing off of the enormous sum of $7,113,463 for depreciation and obsolescence of plants. Anaconda has always been noted for making liberal allowances for depreciation, but never had it done anything so radical as this—the writing off of about 13% of its book value. In explanation of it is the remark that $3,668,226 is the book value of plant that is expected to become obsolete, though it is still being used. A year of great profit is a fine time for the exercise of sound accounting.

Interesting features of the report are the summaries of the result of the great program of metallurgical improvement instituted about three years ago. During 1914-16 there was spent $13,645,908 on this account. At the end of 1916 all of that money had been recovered, besides $2,848,567 additional. The ultimate recovery of the copper in the ore was 78.182% in 1913. In the last six months of 1916 it was 90.521%. If the company had treated its ore in 1916 in the same way as in 1913 it would have got 40,641,265 lb. less of copper, 1,412,522 oz. less of silver, and 3514 oz. less of gold. This is the verdict on the new metallurgy of Anaconda about which so much has been heard.

Drill Steel and Drill Bits for Metal Mining

In this issue of the *Journal* we devote more space than is customary to one article, but this one in our judgment will long be a classic in its field and does not lend itself to subdivision. Much has been written on the results of individual effort to solve the drill-steel and drill-bit problem, but unfortunately pressed for either footage or tonnage or limited by other commercial factors, individual mining companies have not progressed nearly so far in solving this question as they have in finding the more suitable type of machine drill.

With the introduction of the hammer-drill type and the use of hollow drill steel, the breakage of drills became in some cases so great and expensive an item that it seemed necessary to abandon this type of drill despite its advantages of lightness in weight and rapidity of drilling. It has been left, therefore, for drill manufacturers to do the greatest amount of scientific investigation along these lines. In this work they have had the coöperation of many of the foresighted mining companies, and results attained have been so great that only the heartiest cooperation between these two may be expected from now on.

The first time that this question of drill-steel breakage ever received serious public attention and discussion was at a meeting of the Mining and Metallurgical Society of America, in New York, Jan. 31, 1914. All the suggested causes of this trouble at that time were speculative, but it is extremely interesting to note that they have all been borne out by the experience of the intervening years, which is crystallized in the article to which we refer, by Mr. Gilman, of the Sullivan Machinery Co., which has shown the true spirit of coöperative research.

The solution of the drill-steel problem seems to be, in the first place, insistence upon a higher grade of steel than is commonly sold for the purpose. This need not necessarily be a much more expensive steel, but it should pass a rigid inspection and conform to strict specifications. Care in manufacture, as well as proper composition, is equally important.

The devising of a new type of bit combining the advantages of all the old types and without any of their disadvantages, the dream of every inventor, seems much nearer of accomplishment in the new double-arc type developed by Mr. Gilman, judging by results, than could have been expected. With the old drill steel and any of the old types of bit, the drilling machine had about reached its limit of development in the way of frequency and force of blow. With carefully manufactured steel of proper composition and with the new type of bit, much more powerful machine drills can be used than ever before, and although not given to prophecy, we look forward to most startling strides in rate of drilling and reduction of drilling cost in the next few years, which can be both hastened and increased by fullest coöperation between the miner, the steelmaker and the drill manufacturer.

Heavier Loading of Cars

One very important but seldom thought-of means of aiding the relief of freight congestion, to which shippers might well give serious attention, is the heavier loading of freight cars. The 12 shipping companies of the United States Steel Corporation during 1916 loaded their cars to within 0.5% of their average rated capacity. This was a load per car of only 1800 lb. more than in the previous year, and yet on the total tonnage moved there was effected an actual saving of 37,202 cars, as compared with the loading requirements for the previous year. This means that 37,202 cars were available for other traffic purposes without in any way decreasing the service of the steel company.

This matter could well be given serious consideration by smaller shippers than the Steel Corporation, and it is obvious that it is to the mutual advantage of all shippers and consignees that cars should be loaded to capacity. The ramifications of this problem are too complex to reduce to figures, but are interesting to contemplate, such for instance as the less number of cars to be handled over the line and at terminals by the railroads, the saving to the railroads on this account, together with the savings in hauling the excess loads due to underloaded equipment. A keen analyst might trace this directly to the profit-and-loss sheet, and it is not at all impossible that the railroad revenues could be so increased by this action on the part of shippers that the roads would be relieved from the necessity of asking for higher freight rates.

Belgian Kiddies Ltd. subscriptions up to day of going to press, May 9, amounted to $89,361.

BY THE WAY

Every once in a while a trader will remark the curious fact that before the war, with copper at 12c. per lb., Anaconda was selling at the equivalent of its price now, remarks the *Evening Post.*

Figures made public at the meeting of the Utah Copper Co., held in Jersey City, N. J., on Apr. 27, showed that next to the Kennecott Copper Corporation, which owes approximately 600,000 shares, the Bankers' Trust Co. has the largest holding in the Utah Copper Co., with 84,000 shares to its credit. The total number of holders of Utah Copper shares is about 5000. Some of the largest stockholders, according to the *Tribune*, are Hayden, Stone & Co., 60,000; Central Trust Co., account R. W. Allen, 10,000 shares; Nathan Allen, 7000 shares; J. S. Bache & Co., 41,694 shares; Fred Edey & Co., 17,370 shares; C. M. MacNeill, 30,000 shares; Richard A. F. Penrose, Jr., 32,302 shares; Spencer Penrose, 38,773 shares; W. Hinkle Smith, 20,000 shares; Alvin Untermyer, 20,240 shares; Samuel Untermyer, 4000 shares; Isaac Untermyer, 7000 shares, and George E. Warren, 22,110 shares. Of the directors, D. C. Jackling has about the smallest amount of stock in his own name, his total holdings being 600 shares. Charles Hayden stands credited with 2000 shares.

Once more, Charles H. Unversagt, of 103 Park Ave., New York, long connected with the promotion of the Lightning Creek Gold Gravels and Drainage Co., the Lightning Creek Co., et al., has run afoul of the Post Office Department. Just four years ago, says the *Sun* Unversagt came into the limelight when post-office inspectors took exception to the character of literature he was sending through the mails—under the name of a guileless country editor—to exploit his company. Again a warrant was issued for his arrest in London when he was charged with sending libellous post cards through the English mails to his former stenographer, Miss Alice Smith. Unversagt on May 3, 1917, admitted sending out literature under the name of Dr. D. F. Pennington, who died four years ago. His purpose, it developed, was a hatred of England and his belief that President Wilson is trying to curb free speech. Unversagt had been sending his circulars to Washington for several months. The Post Office Department assigned two inspectors to find him. All of the literature was signed "Dr. Pennington." Among the circulars sent out by Unversagt was one labelled "Enlist and fight for John Bull," and another "Patriotism is the refuge of scoundrels." On being haled before Assistant District Attorney Talley by the post-office inspectors, Unversagt, who is 58 years old, was permitted to go on a promise to refrain from further distribution of such literature. But it is hard to teach an old dog new tricks.

Thomas A. Edison is busy on an experiment of such importance that he could not get away from his laboratory even long enough to grant a request from the British and French commissions, President Wilson and all his Cabinet members that he make a trip to Washington to meet the members of the international war council; said the New York *Sun.* Arthur J. Balfour, England's Secretary of State for Foreign Affairs; Marshal Joffre, France's idol; former Premier Viviani and the other guests of America recently expressed a desire to meet Mr. Edison. Secretary of War Baker sent a telegram asking the inventor to come to Washington, repeating the expressions of the distinguished visitors. A telegraphed answer from Mr. Edison said he was "too busy." Secretary of the Navy Daniels thereupon sent a telegram saying the members of the commissions were planning to leave Washington soon for a Western trip and would like very much to meet Mr. Edison. Again the answer came to Washington, "Too busy." President Wilson then tried. He also was informed that the inventor was "too busy." Mr. Edison explained to the President, however, that all his time nowadays is being devoted to work in the interests of the Government and that recently he had got into a "critical period" of an experiment and could not leave it. Hidden away in his laboratory Mr. Edison is putting all his mental concentration on "something or other," as it is explained, "that will help his Uncle Sam."

Literature on the mule underground has been enriched by this contribution from the New York *Herald.* Any one who has ever been in a hurry—and in the name of Mercury, who has not?—will recall that the last spine-fracturing straw is to have a surface car block develop which is so long that those in the last 10 cars can't even learn the reason for it. If there is anything a surface car customer wants above all things it is a reason, even though his own is tottering. Well, the reason for one of the longest blocks which Seventh Ave. has known in months is that Bennie, a brunette mule, came out into the open yesterday. Bennie, who is not used to being on the level, has been at work in the subway excavations for the last three months, during which time nothing has developed upstairs to require his presence. But yesterday he was led forth via a runway at Fifty-first St. and Seventh Ave. and did there and then conduct himself in such a manner that he was galloped back into the city's basement again. Not, however, until he had contributed at length to the alternating annoyance and gayety of the metropolis. Wellington Pearl, who is 18 years old, the same color and a head shorter than Bennie, was technically in charge of the mule when the two came into the light at half-past twelve. Within a moment, however, Wellington was second in command. The entire change of front took place on the car tracks and the blockade grew and grew. Immediately upon reaching the surface Bennie left it, going out for the mule altitude record of 20 ft. Wellington Pearl went up for 10 and volplaned, but luckily landed on his head and was unhurt. He regained a hold upon Benny's hemp cravat and attempted to lead the way anywhere but where they stood. Half an hour afterward Bennie was still rolling around the car tracks, squealing, kicking and otherwise disporting himself as only Bennie and his relatives can. At five minutes after one Policeman Coyle kicked Bennie toward the runway and Bennie kicked Policeman Coyle toward Broadway, and at just ten minutes after one Bennie ran away and dragged Wellington Pearl back into the excavation again. Considering that Bennie is but an extremely common mule he had done fairly well.

Personals

M. L. Fuller has gone to Missouri.

Ralph W. Perry is at Oatman, Ariz.

C. T. Griswold is doing geological work in Oklahoma.

Mark R. Lamb has arrived in New York from South America.

J. E. Johnson, Jr. has returned from a business trip to China.

Dr. Ernest Marquardt is in Wyoming in connection with oil investigations.

W. G. Swart, mining and metallurgical engineer of Duluth, Minn., is in New York.

Adolph Lewisohn has contributed $5000 toward the liberty statue, to be given by American Hebrews to Russia.

F. G. Clapp, of the Associated Geological Engineers, has returned to New York after an absence of most of the winter.

Charles Whiting Baker has resigned as editor-in-chief of the "Engineering News-Record," New York, and is succeeded by F. E. Schmitt.

Kirby Thomas has returned from Brazil where he has been making examinations of iron, manganese and gold properties in the state of Minas.

Dyke V. Keedy is in French Guiana, South America, where he has been since January examining and proving up some extensive deposits of bauxite.

Frederick K. Brunton, formerly assistant superintendent of the Consolidated Arizona Smelting Co., has been promoted to superintendent of the same company.

C. E. Visel, who was superintendent of the Mile Wide Copper Co., near Tucson, Ariz., announces that he severed his connection with that company on Mar. 24.

Henry N. Thomson has resigned as metallurgist with the United Verde Copper Co., and is engaged in consulting practice at 918 South Kingsley Drive, Los Angeles.

Herbert N. With, geologist for the Goldfield Consolidated Mines Co., will make an extensive trip through British Columbia for the exploration department of his company.

George Otis Smith, director of the United States Geological Survey, has been appointed, at the request of the President, a member of the National Research Council.

Edwin W. Mills was in Mukden, Manchuria, on Apr. 15, en route from Seoul, Chosen, to Peking, China. He expects to return to the United States in June of this year.

Lawrence Addicks is chairman and B. B. Thayer a member of the sub-committee of the Naval Consulting Board that has in hand the matter of overcoming the U-boat menace.

A. E. Drucker and G. W. Laurie have established an office at 30 Church St., New York, for the practice of consulting metallurgical engineering. The firm name is Drucker & Laurie.

Prof. G. Howell Clevenger has been appointed research professor of metallurgy at the Leland Stanford Jr. University, Palo Alto, Calif., having been relieved of elementary and routine teaching.

E. C. Bauer, who has been connected with the sales department of the American Manganese Steel Co., Chicago, for a number of years, has been appointed to the office of assistant to the vice-president.

Eugene G. Grace, president of the Bethlehem Steel Co., was elected a director of the American Iron and Steel Institute, at a meeting held in New York, Apr. 25. Mr. Grace succeeds the late Frank S. Witherbee.

Henry D. Williams and his partner, William S. Pritchard, announce that the name of the firm for the practice of patent and trademark law will be Williams & Pritchard hereafter. The same offices at 61 Broadway will be continued.

Victor C. Alderson, in company with John M. Baker and Hamilton W. Baker, has established the firm of Alderson, Baker & Baker, consulting mining engineers, with offices at 185 Devonshire St., Boston, Mass., and Falk Building, Boise, Idaho.

F. B. Laney has prepared metallographic descriptions of the Ducktown district of Tennessee and the Leadville district of Colorado. The work was done jointly for the Geological Survey and the Bureau of Mines and will be published soon by the former.

L. M. Prindell, of the Geological Survey, will go to northern California and Oregon to systematize measures for avoiding waste of platinum encountered during placer operations for gold. It is hoped to increase the platinum production by careful study and conservation.

D. B. Gallagher, formerly superintendent of the bar mill of the Pittsburgh Crucible Steel Co., Midland, Penn., has been appointed superintendent of the blooming and billet mills. C. S. Capehart has been appointed to succeed Mr. Gallagher as superintendent of the bar mill.

Obituary

J. R. Lucas, of Phillipsburg, Mont., died at Long Beach, Calif., on Apr. 16, at the age of 52. The body was returned to Phillipsburg for burial.

Maj. Howard C. Symmes was killed in action recently while serving at the front with the South African Infantry. Major Symmes, who was in his forty-third year, was a Canadian and graduated in science at McGill University. He went from Guelph, Ont., with the Canadian contingent in 1897 to South Africa, where he served through the Boer War, and at its close obtained a position in the Bureau of Mines in Johannesburg. He enlisted on the outbreak of the present war and was promoted to the rank of major on the field.

Edgar Smart was murdered by natives in East Africa in December last. Details are lacking, but official reports intimate that he was mistaken for a German. He was known as co-editor with H. Forbes Julian of "Cyaniding Gold and Silver Ores," a treatise which for several years was considered a standard text-book on the subject, particularly in reference to South African practice with which both Julian and Smart were especially identified. After Julian's death on the Titanic the work of revising and re-writing the book for a third edition was comenced by Smart in collaboration with A. W. Allen, but publication has been delayed on account of the war.

Albert Jenks Robinson died at his residence, 210 Winthrop Road, Brookline, Mass., May 2, 1917. He was born in Raynham, Sept. 13, 1831. He was formerly a prominent iron manufacturer and merchant of Boston, the firm name being Leeds, Robinson & Co. It was connected with the Old Colony Iron Co., which was founded by his father, Charles Robinson, who was associated with the Wareham, Plymouth, and other Massachusetts iron concerns. His ancestors were pioneers in the iron and steel industry. Two daughters, Mrs. James E. Chapman, and Miss Emily M. Robinson of Brookline, and a brother, Edgar Robinson of Chestnut Hill and Chicago, survive him.

Edwin J. Haddock, formerly of New York, died in Pittsburgh, Apr. 11, as the result of an automobile accident. Mr. Haddock was a mechanical engineer and held many positions of responsibility. He was for several years with Thomas A. Edison; chief draftsman for Robins Conveying Belt Co., of New York; chief engineer for Jeffrey Manufacturing Co. of Columbus. Later he was with the Tennessee Coal Co. of Birmingham, Alabama; in private practice in Milwaukee; and chief engineer of the Edgewater Steel Co. of Pittsburgh at the time of death. He leaves a wife and son, Gerald T. Haddock, a student at Columbia University, New York.

Charles Duncan Fraser of Ardsley-on-the-Hudson, died on March 7 at the Presbyterian Hospital, New York. He was born in South Shields, England, in 1857. He first entered the employ of Oliver Brothers, iron manufacturers, of Pittsburgh, and was for 20 years secretary of the Oliver Iron Mining Co., now the Iron Ore Department of the United States Steel Corporation, from which he retired several years ago. Mr. Fraser was a director of the Hedley Gold Mining Co., Greene Consolidated Copper Mining Co., and the Old Eureka Mining Co. He was also a member of the Engineers' Club and the New York Athletic Club. He received an honorary degree of M. S. from Lafayette College and was a life member of the Sons of St. Andrew. He is survived by his wife and one son, Duncan Fraser, a student at Harvard University.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Aluminum-Calcium Alloy and Process of Making the Same. Hugh S. Cooper, Cleveland, Ohio, assignor to the Cooper Co., Cleveland, Ohio. (U. S. No. 1,224,362; May 1, 1917.)

Calcining Furnace. William R. Clymer, Lakewood, Ohio, assignor to National Carbon Co. (U. S. No. 1,223,475; Apr. 24, 1917.)

Copper Hydrometallurgy — Hydrometallurgical Apparatus for the Recovery of Copper. Edward Ray Weidlein, Thompson, Nev., assignor to Metals Research Co., New York, N. Y. (U. S. No. 1,223,454; Apr. 24, 1917.)

Copper Hydrometallurgy—Hydrometallurgy of Copper. John C. Greenway, Warren, Ariz., and Harry W. Morse, Los Angeles, Calif. (U. S. No. 1,224,458; May 1, 1917.)

Cyaniding—Dehydrator. Charles Biesel, El Paso, Tex. (U. S. No. 1,223,245; Apr. 17, 1917.)

Drilling—Rod-Lifting Tool. John M. Miller, Eagle Pass, Tex., assignor of one-half to Osie S. Harper, Eagle Pass, Tex. (U. S. No. 1,223,714; Apr. 24, 1917.)

Electric Steel Furnace. Joseph Lawton Dixon, Detroit, Mich. (U. S. Nos. 1,214,763 and 1,214,764; Feb. 6, 1917.)

Flotation—Apparatus for Separating or Concentrating Ores. David Cole, Morenci, Ariz., assignor, by mesne assignments, to Metals Recovery Co., Augusta, Me. (U. S. No. 1,223,033; Apr. 17, 1917.)

Furnace Dead-Plate. Adelbert W. Pettie, Jr., Boston, Mass., assignor of one-half to Charles N. Morgan, Troy, N. Y. (U. S. No. 1,223,828; Apr. 24, 1917.)

Ingot Mold. George A. Dornin, Baltimore, Md (U. S. No. 1,223,775; Apr. 24, 1917.)

Ingot Mold and Ingot Produced Thereby. Alexander Fielder Clarke, Pittsburgh, Penn. (U. S. No. 1,224,277; May 1, 1917.)

Lamp—Acetylene Lamp. Augie L. Hansen, Evanston, Ill., assignor to Justrite Manufacturing Co., Chicago, Ill. (U. S. No. 1,224,537; May 1, 1917.)

Metal Vapors—Vapor Treatment of Metals. William A. Darrah and Samuel Trood, Wilkinsburg, Penn., assignors to Industrial Development Co. (U. S. No. 1,224,339; May 1, 1917.)

Mine-Car Wheel and Attaching Means Therefor. Frederick H. Gibbs, Brooklyn, N. Y., assignor to American Car and Foundry Co., New York, N. Y. (U. S. No. 1,224,736; May 1, 1917.)

Mining Method. Trimble de Roode, New York, N. Y. (U. S. No. 1,224,613; May 1, 1917.)

Mine Railroads—Cross-Tie for Mine Railroads or Track Constructions. Ernest Hutton, Wayland, Ky. (U. S. No. 1,223,171; Apr. 17, 1917.)

Molten Steel—Apparatus for Handling Molten Steel. James C. Davis, Hinsdale, Ill., assignor to American Steel Foundries, New York, N. Y. (U. S. No. 1,223,479; Apr. 24, 1917.)

Nickel Flux—Flux for Welding Nickel and Nickel Alloy. Richard Samesreuther, Dusseldorf, Germany, assignor of one-half to the firm of Autogenwerk Sirius, Gesellschaft mit beschrankter Haftung, Dusseldorf-Eller, Germany. (U. S. No. 1,224,418; May 1, 1917.)

Nodulizing Kilns, Cooling Plate For. Richard V. McKay, Steelton, Penn. (U. S. No. 1,222,646; Apr. 17, 1917.)

Ore Classifier. Edison C. Robinson, Telluride, Colo. (U. S. No. 1,223,523; Apr. 24, 1917.)

Ore Concentrator. James H. Brittain, Salt Lake City, Utah. (U. S. No. 1,224,066; Apr. 24, 1917.)

Ore Concentrator—Coal Washing and Ore Concentration. Thomas M. Chance, Philadelphia, Penn. (U. S. No. 1,224,138; May 1, 1917.)

Ore-Separating Machine. Herbert Huband Thompson, Aldridge, and Alfred Evan Davies, Hockley, Heath, England. (U. S. No. 1,224,580; May 1, 1917.)

Regenerative Furnace. Horace E. Smythe, Pittsburgh, Penn., assignor to S. R. Smythe Co., Pittsburgh, Penn. (U. S. No. 1,222,690; Apr. 17, 1917.)

Rescue Work—Absorbent for Carbon Dioxide in Breathing Apparatus for Use in Mine-Rescue Work or Like Purposes. Edward John Bevan, London, England. (U. S. No. 1,223,244; Apr. 17, 1917.)

Rifle-Box. Arthur E. Custer, Salt Lake City, Utah. (U. S. No. 1,224,281; May 1, 1917.)

Sampler—Automatic Sampling Device. Carl A Wendell, Joliet, Ill. (U. S. No. 1,223,544; Apr. 24, 1917.)

Smelting Furnace. Edwin Ruck, Swansea, Wales. (U. S. No. 1,223,738; Apr. 24, 1917.)

Smelting Furnace. John Kirby, Leechburg, Penn., assignor of one-fourth to Owen Kirby, Leechburg, Penn., one-fourth to James B. Sommerville, Wheeling, W. Va., and one-fourth to Samuel M. Boyd, Pittsburgh, Penn. (U. S. No. 1,222,636; Apr. 17, 1917.)

Steel—Manufacture of Steel. Frank D. Carney and Lewis B. Lindemuth, Bethlehem, Penn. (U. S. No. 1,223,030; Apr. 17, 1917.)

Steel-Making Process. George G. McMurtry, New York, N. Y., assignor to United States Steel Corporation, Hoboken, N. J. (U. S. No. 1,217,972; Mar. 6, 1917.)

Titanic-Oxide Pigment—Composite Titanic-Oxide Pigment and Method for Producing the Same. Louis E. Barton, Niagara Falls, N. Y., assignor to the Titanium Alloy Manufacturing Co., New York, N. Y. (U. S. No. 1,223,357; Apr. 24, 1917.)

Titanium Oxide—Titanic-Oxide Product and Method of Obtaining the Same. Louis E. Barton, Niagara Falls, N. Y., assignor to the Titanium Alloy Manufacturing Co., New York, N. Y. (U. S. No. 1,223,356; Apr. 24, 1917.)

Titanium Sulphate—Method for Producing Basic Titanic-Sulphate Products and Pure Titanic Oxide Therefrom. Louis E. Barton, Niagara Falls, N. Y., assignor to the Titanium Alloy Manufacturing Co., New York, N. Y. (U. S. No. 1,223,358; Apr. 24, 1917.)

Tungsten—Process for Producing Homogeneous Articles of Any Desired Form Out of Pure Tungsten Otto Voigtlander, Essen-on-the-Ruhr, Germany. (U. S. No. 1,224,242; May 1, 1917.)

Zinc-Iron Solutions—Method of Recovering Zinc and Iron from Solutions Thereof. Charles E. Baker, Chicago, Ill. (U. S. No. 1,224,057; Apr. 24, 1917.)

Editorial Correspondence

SAN FRANCISCO—May 2

Angels Camp District, in Calaveras County, has for some time been unusually active. Besides the work on the Calaveras Consolidated, near Melones, nearly all of the old properties along the Mother Lode from Altaville to Stanislaus River are being reopened or unwatered. The unwatering of the Pioneer shaft is completed and it is expected that work will be resumed in a few days. The Australian grinding pan installed at Angels mine is being adjusted to commercial operation. There is still a scarcity of labor in the lower end of the county.

Mexican and Consolidated Virginia Mines, on the Comstock Lode, in Nevada, continue to show at depth good-grade ore, considering the size of the orebodies developed on the 2700 level of these north-end mines. Official reports for the last week state that the Mexican extracted 20 tons of porphyry and quartz averaging $25.75 per ton from one end of a lateral drift and that the bottom showed a 5-ft. vein sampling $30.86 per ton; and a streak on the hanging wall from a few inches to 12 in. wide sampling $61.17 to $821.63 per ton. In the Consolidated Virginia, 78 cars were saved in the advance of the southwest drift, assaying $16.42 per ton and 75 cars from the raise averaging $11.82 per ton. Further advancing the drift the face was broken to a width of 14 ft. in solid ore and with ore on all sides. Union Consolidated extracted 20 tons from the 2600 level stope averaging $77.80 and shipped to the Mexican mill 202 tons sampling $25.18 per ton. Sierra Nevada on 2450 level showed quartz in north drift running from $10 to $34 a ton and an 18-in. vein in southeast drift on 2700 level varying from $5.34 to $20.91 per ton. Three cars sampled $60.82; 14 cars $18.51 per ton. Altogether it was a fine week on the Comstock; the 527 tons treated at the Mexican mill averaged $24.44 per ton.

Mother Lode Carnival, held at Sutter Creek, celebrating the first anniversary of the reopening of the Old Eureka mine, Apr. 14, was a positive declaration of the purpose of the people to encourage investment in mining. It was a gala day, but none the less a day of serious accounting of moral responsibility of the camp for past lack of encouragement to mining. The present producing mines of Amador County, both the old ones and the recently reopened properties, have stood together for the general prosperity of the region, and when the purpose of celebrating the establishment of a new state of mining and business affairs in the Sutter Creek district was announced there was hearty coöperation all along the Lode. A drilling contest between Old Eureka and the Jackson teams was won by Jack Larsen and Al. Beck for the Old Eureka by drilling 41⅜ in. in 15 min. against John Burbank and John Millovich, who drilled 36⅝ in. in the granite. The first-aid contest was won by the Argonaut team by a score average of 96.5 points against 95.7 points by the South Eureka team. The mine-rescue exhibition was given by a joint team of Mother Lode miners participated in by Sam Fitzgerald, Michael Radovich, Dan Millosovich, Andrew Millosovich and Nick Vlaovich, some of whose names are evidence that the spirit of safety is not monopolized by American-born miners.

Mountain King Mine Accident in Maraposa County, reported by telegraph, last week, resulted in the death of seven men from powder gases. The men had been working on the 1400 level. A blast had been fired the night before and the men were instructed to work at track laying in the 1200 level and not to go into the 1400 level until the level was cleared. During the preceding night of Apr. 27, a section of flume supplying water for generating electric current was broken by a washout. This break caused a shutdown of the entire operating plant including hoists and air compressor. Though it was safe to go as far down as the 1200 level, which the powder fumes had not reached, it was evidently unsafe to go below that point while the air was shut off. During the morning, with the consent of the foreman, two of the men went down the winze to the 1400-ft. level to see how the ground had broken. When they did not return within 30 min., the foreman and another man went down and evidently found the men overcome by gas and did all they could to rescue or revive them. A short time after three others followed and evidently tried to save some of them but they were also overcome, and the foreman and one other were found lashed to the manway ladder about 40 ft. apart. The eighth man reached the point where he saw the two men on the ladder, and returned to the surface to obtain some ammonia. All he was able to do was to apply the ammonia to the nostrils of the men by using strips of gunny sack. He was badly overcome himself, but finally reached the 1100 level, and was found there some time after, still alive but unconscious. The superintendent, B. C. Austin, had accompanied the men repairing the flume; upon his return to the mine after being called he went down and found conditions as stated. He was nearly overcome, but managed to escape serious results. The complete details of the tragedy are not available as the report of the coroner's jury has not yet been received. The bodies were recovered about midnight of Saturday. The mine is operated under strict rules, but does not employ enough men to demand compulsory use of breathing apparatus. However the accident is another demonstration of the great value of breathing apparatus, even in the smaller mines. Although the primary cause was the shutting off of the compressed air and the fact that a duplicate or supplemental plant had not been installed, yet the actual cause was the disobedience on the part of the men of strict orders given to keep out of the 1400 level until the level was cleared.

Mining in San Luis Obispo County is having a revival of importance that is attracting attention to the gold and copper resources as well as quicksilver, for which it is chiefly noted. For several years the mineral production of the county has been confined to quicksilver, bituminous rock, building stone and mineral water. The mineral possibilities, however, are diversified to an extent not generally known, chiefly because the mineral districts are isolated from rail and water shipping points. There have been developed to a limited extent antimony, chromic iron, gypsum, diatomaceous earth and limestone, marble, onyx, petroleum, besides the quicksilver ores and placer gold and gold, silver and copper ores. In 1913 and 1914 the total production of the county, including quicksilver, was valued at less than $65,000 in each year. In 1915 the total production amounted to $277,632. The increased price of quicksilver and an increase of about 200 flasks in 1915 compared to 1914 added $63,445 to the total value. In 1916 not only was the quicksilver production increased, but also the copper and gold output. The Oceanic quicksilver mine at Cambria in the summer of 1916 increased its mining and milling capacity to about 400 flasks per month, as described in the "Journal" of Sept. 16, 1916, and is now reported to be mining some of the richest ore in the history of the property. The Klau quicksilver mine, which stood idle for a long time on account of fire and other unfortunate conditions, is working full time; and other quicksilver mines are adding to the output. Copper has received attention, particularly at the Quist mine in Los Osos district, where the installation of a mill is said to be in progress; the mine is developed by a 400-ft. tunnel. In La Panza district it is reported that old placer mines, long ago abandoned by Spanish miners, are being reopened and a large aggregate amount of work is being done. Exploration and development undertaken during the year will direct attention to San Luis Obispo County and in the future it is likely to attract a larger share of mining investment than has been heretofore accorded.

BUTTE—May 4

Mine-Fire Situation in the Modoc mine of the Anaconda company continues to improve. All the pumps in the mines affected by the fire are now working. At the High Ore, a new air line is being run down through the Parnell shaft, which will probably permit resumption of operations in that mine within a day or two. At the Speculator and Granite Mountain of the North Butte company operations were resumed Apr. 29, and it is expected that the Butte-Ballaklava will be started up next week. As some of the gas from the Modoc had worked through into the Tuolumne mine of the Tuolumne Mining Co., the management thought best not to take any chances and ceased operations Apr. 31, awaiting the clearing away of the smoke. Anaconda will resume mining in the Rarus, hoisting temporarily through the Pennsylvania shaft.

Flotation Suit of Minerals Separation against Butte & Superior continued through the week, with testimony by the latter's experts to establish the contention that the Minerals Separation patents were anticipated by previous patents and that in many mills using more than 1% oil perfect results were obtained. Experiments on a small scale were performed in the presence of the court to demonstrate the feasibility of some of the processes described in previous patents. A special point aimed at was to prove that there is no critical point in the process but that the varying amount of oil per ton used merely affects in a general way the results obtained. On Sunday the attorneys, experts and other representatives of the Minerals Separation company were the guests of the Butte & Superior company at the mine and mill of the latter. The entire party was taken through the plant and 10 experts picked from the ranks of the plaintiffs were given the opportunity to take samples and data on the operations and output of Butte & Superior's flotation process. The court is holding night sessions now to permit the introduction of stereoptican views, which give an enlargement of photographs taken in the course of experiments that have a bearing on the outcome. Prof. F. H. Taggart, of Yale, was one of the leading witnesses. He presented data secured by him on the operation of the flotation process at the Arthur plant of the Utah Copper Co. He also went into the scientific phases of the amount of oil required and the effect of varying amounts on the results. There are three different conditions, he declared, that affect the amount of oil needed: One was the amount of agitation; another the amount of sulphide mineral present; and the third, the amount of water present. In support of his contentions he gave experiments. The testimony of Prof. Frederick E. Beach, of Yale, was also important as backing up that of Dr. Taggart, and gave data on experiments that he had carried on. He was asked the question, "Do you recognize any difference in the process from a minimum of something less than a pound of oil to the ton of ore up to the conditions of 200 lb. of oil to the ton of ore?" In reply he said: "I can see no difference in the physical phenomena and the principle of the process." Strenuous efforts are being made by the defense to bring in testimony that will bring about a reversal of the position taken by the U. S. Supreme Court, in which the use of less than 1% of oil was fixed as an infringement of the patents of the Minerals Separation company. Dr. Bancroft, of Cornell, spent one day on the stand and his testimony was in line with that given by the Yale scientists. With a large array of experts on both sides yet to be examined, the suit may continue for several weeks.

DENVER—May 3

Silver Plume Experiencing Revival that approximates boom-camp conditions and it is nearly impossible for miners to find lodging. This is largely the outcome of the application of improved metallurgy to base ores that were formerly not profitable. At the Wasatch mill, of the Wasatch-Colorado Mining Co., the lead concentrates in March averaged over $80 in value and the zinc concentrates about $45. This company is employing about 100 men. Other activities in the district have made the labor problem acute, as it is elsewhere in Colorado.

Interest in Oil is so pronounced in Denver that, besides Wyoming and the Mid-Continental field, more attention than ever is being directed to the older Colorado fields and the search for petroleum has spread over virgin areas along the northern border of the state in Routt, Moffat, Weld and Logan counties, as well as in the southern counties of Pueblo and Las Animas. As school land, the state owns extensive areas classified as oil-bearing, and application for leases thereon are coming in rapidly. Terms under which the state land board grants leases are strict and every effort is made to prevent the occupancy of the land for purely promotion purposes. A lessee is required to install his plant, to get under operation and to drill at least 2500 ft. on each one-quarter section within six months. Continued occupancy of the ground depends upon the lessee developing a producing well on each quarter section, but this degree of success also entitles him to the possession of one adjoining quarter. If, at the end of the five-year lease, all requirements have been complied with, the lessee may have his lease extended for another similar term. Revenue to the state is in the form of a flat rental of 5c. per acre per year in addition to a royalty of 10% on production.

SALT LAKE CITY—May 4

New Leaching Plant of the Utah Copper Co. should be completed during the early summer months, and preparations are being made by the Bingham & Garfield Ry. to take care of the additional tonnage, which will have to be transported to supply the plant—which is to have a capacity of 4000 tons daily—as well as to meet a probable tonnage increase at the other mills. With this end in view, two new Mallet engines and a pair of switch engines have been purchased, and are on their way to Garfield. Most of the masonry for the leaching plant is finished. The machinery remains to be set up, and a large part of this is in transit from Eastern manufacturing plants.

Deep Creek Railroad, recently completed, is operating satisfactorily. Material for more comprehensive map of section is being collected by R. M. Crocker, of Salt Lake City. The camp of Ferber is showing increased activity with the coming of warmer weather, both in the work of construction of buildings at the townsite, and in the larger amount of work done at the various mines of the district. Ore is being accumulated for shipment. The Big Chief (lead-silver) and the Sheridan (copper) properties have been taken over by the Western Mines Development Co. Copper ore is being mined by the Ferber Copper Company.

TYRONE, N. M.—May 3

Tyrone and Burro Mountain Region are active. The Burro Mountain Copper Co. is milling about 40,000 tons monthly. The model town of Tyrone is receiving its finishing touches; new store building, one of the finest in the Southwest, is completed and the other important structures are finished with one or two exceptions. Several new mining operations have been begun around Tyrone and apparently much development will be in progress during the coming summer. The Austin-Amazon lately opened 30 ft. of chalcopyrite ore on the 70-ft. level. While there is more mining going on in the camp today than at any time in its history, there are also more unemployed men than ever before. It is understood that this is true of some other Southwestern camps.

DULUTH, MINN.—May 3

Loyalty of Young Engineers is evidenced by the engineering class of the University of Minnesota, which has offered its services to the United States Government for war work, adopting the following code: "We stand ready to respond to the call of the country in ready and willing service. We undertake to maintain our part of the war, free from hatred, brutality or graft, true to American purpose and ideals. Aware of the temptations incident to camp life and of the moral and social wreckage involved, we covenant together as college men to live the clean life and to seek to establish the American uniform as a symbol and guarantee of real manhood."

Navigation Opened May 1 on the Great Lakes, when 16 vessels arrived and 15 departed from the Duluth-Superior harbor, four of which carried ore. The first boats leaving were the "Joseph Black" and the "N. F. Leopold," of the Inland Steamship Co.'s fleet, laden with ore from the Armour No. 2 mine and the Thompson mine, on the Cuyuna range. Extra precautions have been adopted by the military authorities in guarding the ore docks since loading has started. War zone has been established along entire water front and guards placed at detached posts. Orders have been given to shoot to kill if any person refuse to halt after being challenged. Crews on vessels are subject to examination and packages brought toward the docks and vessels are thoroughly inspected. The Interstate Commerce Commission has authorized an increase of 15c. per ton in rates on iron ore from lake ports to furnaces in Pennsylvania and Ohio.

JOPLIN, MO.—May 5

Conditions in Joplin District, as to mining costs and production, were brought before the government metals committee this week by two local producers, Temple Chapman, of Joplin, and W. B. Shackelford, of Webb City. They went to Washington early in the week and were given an audience Thursday, and have reported that the hearing was satisfactory. The plan of the representatives was to endeavor to show the government that producers here are making only narrow margin of profit and cannot make this if spelter prices are not maintained around 10 cents.

Important Decision by Secretary Lane, affecting a one-third interest in a million-dollar mining tract, was handed down last week in the matter of the Leander J. Fish estate near Century. Fish was a Quapaw Indian who died about two years ago. He was married four times but his fourth wife, a resident of Washington, D. C., was not known here to have been his wife until after his death. Then she signed away her interest in his estate for $10. Fraud was alleged and although the Secretary of the Interior once ruled that her claim was invalid, he reversed this decision and gave her a third-interest in the 200 acres of mining land that Fish owned. Upon this land is situated the Montreal mine, one of the richest zinc-producing properties in the world; it has produced $700,000 worth of zinc ore since the first of the year. By the decision the widow, who remarried while her husband was still alive but, according to representations of her attorney, only after she had been informed by the land owner that he had divorced her, is also given a one-third interest in all the lead and zinc that already has been taken from the land. Mining men here have estimated the value of the 200 acres as not less than one million dollars. Mrs. Josephine Fish-Unkle, the widow, has never been in the district.

TORONTO—May 5

Flotation Litigation at Cobalt now seems likely, as the Minerals Separation company has notified the Dominion Reduction Co. that further use of the process will be considered an infringement of its patent rights. The Canadian companies using the Callow process have heretofore felt that this system presented some essential differences from that in use under the Minerals Separation patent.

Treatment of Flotation Products is being studied at the Buffalo and Dominion Reduction plants at Cobalt by Theodore P. Holt, of Salt Lake City, one of the developers of the chloridizing-leaching process used in Utah, and of the Holt-Dern roaster used in connection therewith. Thus far it has been necessary to ship the product of Cobalt flotation plants to a distance for treatment, the cost involved being a considerable drawback to the adoption of the flotation process. The purpose of the present experiments is to determine the feasibility of local treatment, and it is stated that in addition to the original object in view the results are likely to be more far-reaching, and that table as well as flotation concentrates may be made amenable to the process, and shipments confined to bullion.

JOHANNESBURG—Mar. 19

Water at East Rand Proprietary Mines has given rise to considerable uneasiness on the part of the stockholders as to the immediate future prospects. The development results at a depth of 4000 ft. and over have been unsatisfactory, and the recent attempt to crosscut at this depth for a distance of 2000 ft. and then sink to the reef, has resulted only in tapping a flow of water of five million gallons per day, and the mines were only saved by the construction of a bulkhead in the crosscut. This dam, with a bypass of over half a million gallons daily, shows a pressure of 850 lb. per sq.in., and as the present pumping and bailing facilities are only capable of dealing with five million gallons of water per day, a new pumping scheme is under consideration. Owing to disapproval of the crosscutting scheme, one of the directors resigned some time ago. Now the superintending engineer and also the sectional manager have resigned and R. C. Warriner, of the Crown Mines, has been appointed consulting engineer. The future doings of the board of directors will be watched with considerable interest.

The Mining News

ALASKA

ALASKA GASTINEAU (Juneau)—Milled in first quarter 541,093 tons, averaging $1.207 per ton; gross revenue, $539,488 or $0.997 per ton; operating expenses, $430,748, or $0.788 per ton; operating profit, $108,740; other income $4303; profit, 20.9c. per ton. In April, milled 212,200 tons, averaging $1.09 per ton; in March milled 217,700 tons of same grade.

ARIZONA

Cochise County

JOHNSON DISTRICT has been shipping about 8000 tons of copper ore per month, furnished principally by the Republic, Mammoth, Black Prince, Copper Chief and Keystone mines. Shipping suspended at last three mines lately. Keystone, notified by smelters that no more open shipments would be received, has been developing low-grade sulphide body at depth. Black Prince also said to be in low-grade ore in 800-ft. level crosscut but has stopped work temporarily. Johnson Copper Development Co. prosecuting development actively and Peabody Consolidated has its new equipment installed and will explore systematically the limestone-diabase contact.

SHATTUCK ARIZONA (Bisbee)—Metal output for first quarter was: copper, 4,336,592 lb.; lead, 1,063,901 lb.; silver, 56,769 oz.; gold, 612 oz. Mined during quarter, 46,644 tons of copper ore and 3571 tons of lead ore. Gross earnings, $1,319,630; net earnings, $696,160; dividends, $437,500. April output: copper, 1,482,232 lb.; lead, 164,979 lb.; silver, 18,233 oz.; gold, 179.83 oz.

Gila County

OLD DOMINION (Globe)—April output from own smeltery was 3,516,000 lb., as compared with 3,335,000 lb. in March.

IRON CAP COPPER (Copper Hill)—March operating profit, $32,327; gross receipts, $68,089. Shipped 21 cars to El Paso smeltery and 26 cars to Old Dominion mill.

INSPIRATION CONSOLIDATED (Miami)—April copper production, 11,400,000 lb., comparing with 11,100,000 lb. in March.

GILA COPPER SULPHIDE CO. (Christmas)—Earnings for first quarter about $125,000. Company owns Christmas mine, which is operated by Southern Arizona Mining and Smelting Co., an American Smelting and Refining Co. subsidiary.

Greenlee County

SHANNON (Clifton)—Copper output in April, 924,000 lb., comparing with 950,000 lb. in March, 880,000 in February and 759,000 in January.

Yanapai County

JEROME VERDE (Jerome)—Drifting east and west from 1050-ft. level of Columbia shaft.

ARKANSAS & ARIZONA (Jerome)—Property being examined for Goodrich-Lockhart syndicate; new development plan may be announced soon.

JEROME DAISY (Jerome)—At 235 ft. shaft broke into water, which rose 6 ft. in shaft. Will cause some delay but no serious complications anticipated.

DUNDEE ARIZONA (Jerome)—Recently shipped three cars of surface ore to Humboldt smeltery. A 50-hp. motor being installed at shaft and electric pump is on the way. Management expects to resume work in the shaft in about six weeks with gasoline hoist. Arizona Power Co. will have additional power ready about Nov. 1.

UNITED VERDE EXTENSION (Jerome)—Management states that more than half of ore now being extracted is from 1300 level, and of higher grade than the average of last year. Shipping about 9000 tons monthly; copper output of first quarter approximately 15,000,000 lb. Construction of new extraction shaft, about 200 ft. from Edith shaft, is proceeding rapidly and new extraction tunnel has been started. The newly organized Arizona Extension R.R. Co. will build 3½ miles of railroad from Clarkdale to smeltery site; will also build 4½ miles of railroad from smeltery to mouth of extraction tunnel. While construction costs will be abnormally high, building of smeltery and railroad at this time considered warranted by present high treatment and freight costs. Most of important machinery and material contracts let for delivery within 12 months. Cash on hand Apr. 1 was $4,226,655. Extra dividend of 25c. declared.

Yuma County

SWANSEA CONSOLIDATED (Swansea)—Reported that this property, lately worked for benefit of stockholders by O. M. Souden, of Los Angeles, trustee, may be sold to the Clark interests.

CALIFORNIA

Amador County

HARDENBURG (Jackson)—Sinking shaft additional 150 ft.; will make total depth 1350 ft.

CENTRAL EUREKA (Sutter Creek)—Preparing to operate all 40 stamps.

ARGONAUT (Jackson)—Expected to have first unit of 20 stamps operating in new mill first week in May.

SOUTH EUREKA (Sutter Creek)—Preparing to deepen Oneida shaft. Will impound tailings in reservoirs now being constructed.

Calaveras County

ANGELS DEEP (Angels Camp)—Unwatering shaft has been started. John C. Benson, manager, has again gone East.

ALLISON (Angels Camp)—Examination made by George L. Holmes, of San Francisco, for Mrs. O. E. L. Fritz, who has option.

MAYPOLE (Mokelumne Hill)—Tunnel started to tap vein below shaft, sunk in early 60's. H. Blackmore, of Stockton, is developing.

LUCAS (Mokelumne Hill)—Mine near Big Bar, on Mokelumne River, to be reopened. Developed by tunnel. Ore formerly transported over a suspension bridge to mill on Amador County side of river.

Imperial County

BARNES & GRIVEL (Calexico)—Recently received equipment for 100-ton dry-concentrating mill. Stebbins Dry Concentrator Co. shipped complete plant in 15 days from order, this haste being necessary because equipment must be hauled over road flooded by Colorado River in springtime.

Inyo County

TUNGSTEN MINES CO. (Bishop)—Upper portion of 300-ton mill in Deep Canyon wrecked by fire on Apr. 27. Fire started in upper crushing compartment where men were using oxy-acetylene torch to cut a piece of steel. Wooden walls and ceiling of mill caught fire. Bucket brigade quickly formed and augmented by chemical fire extinguishers, and hose attached to a big tank on the hill. Fire was stopped before reaching first roller compartment. Crusher room and ore conveyor were wrecked, and about one-third of frame of mill burned.

Plumas County

CHROME DEPOSITS on Clearmont slope owned by Thomas McCarty of Quincy have been optioned by San Francisco men.

Shasta County

MAMMOTH (Kennett)—Copper production in April was 1,850,000 lb.

TEXAS HILL (Old Diggings)—Reported that C. L. Wilson contemplates installation of oil flotation plant.

GRAY EAGLE CO. (Happy Camp)—Exploring Hunter's Paradise copper mine 10 miles south. Old work amounted to 1100 ft. Crosscut adit being driven to vein at depth of 205 ft. vertical below bottom of shaft. Second crosscut adit being driven, 1500 ft. south from shaft; this is now in 510 ft. and has entered porphyry.

Sierra County

JIM CROW (Downieville)—Work resumed by Noyes & Buckingham at this lode mine.

WIDE AWAKE (Downieville)—Contract let to Perrine & Curtis for 100 ft. additional tunnel to be driven before raising. Thomas Wilson, of Downieville, in charge for Reno men.

MONARCH (Sierra City)—Contract let to drive lower tunnel in Black's Canyon to develop vein at much greater depth than present shaft. Additional water being developed. R. G. Gillespie, of Pittsburgh, Penn., operating under bond.

Tuolumne County

CONFIDENCE (Confidence)—Will deepen shaft 800 ft.; 15 men employed and number will be increased.

MUNN RANCH, in the West belt district, is being prospected for copper by W. S. Fagan and associates.

COLORADO

Dolores County

RICO ARGENTINE (Rico)—Leasers shipping about 500 tons per month. On company account, in lower tunnel, considerable ore blocked; temporary tramway being improvised for early shipments.

RICO CONSOLIDATED MINES (Rico)—Development of past winter has placed this Silver Creek group in position to ship base ore regularly as soon as roads permit.

Lake County

PRINCE OF WALES LEASING (Leadville)—Across Arkansas Valley on Sugar Loaf Mountain, operations have been resumed on high-grade silver vein in granite; will ship soon.

SILVER SPOON (Leadville)—Drift will be run northerly 1700 ft. from 300-ft. level to develop orebody disclosed by winze from adit in this property north of Evans Gulch. Warren F. Page in charge.

DOWNTOWN MINES CO. (Leadville)—From the Penrose, regular shipments of low-grade zinc-carbonate ore continue to the local plant of Western Zinc Oxide Co., and of iron-manganese ore to the Arkansas Valley smeltery.

Summit County

FOUR GOLD DREDGES now operating in Breckenridge district and another is being constructed and should be ready for operation by August. The older boats are those of the French Gulch Dredging Co. and of the Tonopah Placers Co., the latter's No. 2 dredge working in the Snider placer in Swan Valley. The new dredge is to work the Lambing placer on the Blue River, 2 miles below Breckenridge.

Teller County

PLATINUM is to be sought in black sand of prehistoric lake above Manitou near Woodland Park, on northern slope of Pikes Peak, by two companies composed of Colorado Springs and Pueblo men—the Rare Metals Co. and the Pikes Peak Platinum Mining and Milling Co.

GRANITE (Victor)—At annual meeting in Cheyenne, officers and directors were reëlected as follows: C. M. McNeill, president; C. C. Hamlin, vice-president and general manager; Spencer Penrose, secretary; C. B. Garnett, assistant secretary; Charles L. Tuft and Michael Finnerty, directors. Shaft is to be sunk to 1800 ft.

IDAHO

Shoshone County

SHERMAN DEVELOPMENT (Burke)—This leasing company, comprising Axel Swan, Charles McKinnis and others, has cut vein showing 4 ft. of galena ore in Sherman tunnel in the old Union ground.

WARDNER LEASING (Wardner)—Sinking shaft to 400 ft. to explore area under town of Wardner. Incorporators include: William A. Beaudry, manager of the Stewart; D. W. Price, of Big Creek Leasing Co.; J. D. Owen, former operator of Butte, Mont.; R. A. Carnochan, of Spokane, and Charles Leonard, of Butte.

COPPER KING (Mullan)—Stockholders rejected proposal to increase capital stock and directors will levy assessment to explore oreshoot struck several months ago. Will sink and raise on ore, also extend drift west; main drift will be continued to ground in which ore was found by diamond drill.

MONTANA-IDAHO (Saltese, Mont.)—Property of Monitor Mining Co. transferred to Montana-Idaho Copper Mining Co. Capitalized for $600,000, divided into 6000 shares of par value of $100. Old company had 1,000,000 shares of par value of $1. Stock exchanged on basis of one for 1000. Crosscut being run from near Adair which will give depth of over 1000 ft. below old Monitor shaft, near summit of Idaho-Montana divide—sunk 700 ft. years ago and from which copper ore was taken and hauled seven miles to Saltese. Crosscut now in 3000 ft. H. F. DeBower, of New York, president.

MICHIGAN

Copper

KEWEENAW (Mandan)—All four new tables at mill now in operation, recovering additional copper.

AHMEEK (Ahmeek)—Over 700 tons a day per head being handled by the eight heads in operation at the mill.

VICTORIA (Victoria)—Mill being enlarged by addition 40x50 ft. and about 14 Wilfley tables will be installed.

WINONA (Winona)—Still short of men. Good ground being opened and stoped on ninth, tenth and eleventh levels at No. 1 shaft.

HANCOCK (Hancock)—Will soon have storage battery locomotive in operation on 49th level and another on 53rd level.

MICHIGAN (Rockland)—Will sink to seventh level and continue drifting on all three lodes. Enlarging of shaft practically completed.

CHEROKEE (Houghton)—Down over 300 ft. with shaft; has done 200 ft. of drifting on 200-ft. level. One drill sinking and two drifting. Better grade rock lately encountered.

MASS (Mass)—Owing to lack of labor, not able to hoist more than 1000 tons daily, though 1300 tons could be hoisted and another shaft started if men could be obtained.

ALLOUEZ (Allouez)—Outputting about 2050 tons daily. Equipment for electric-haulage system being rapidly installed; trolley locomotives will be in operation soon.

NORTH LAKE (Lake Mine)—Now 1000 ft. from shaft in crosscut on sixth level; just entering amygdaloid. The sandstone passed through disclosed some mass copper. Southeast drift on new lode is in good commercial grade.

SOUTH LAKE (Houghton)—Commenced cutting tunnel into bluff just back of shaft on surface in order to get into the Butler lode; fifth opening on this lode. Drift on No. 3 lode to connect with the Lake mine for ventilation purposes, has about 400 ft. more to go.

LAKE (Lake Mine)—Five drills operating on the Butler and Knowlton lodes; drifting on sixth level on the Knowlton, and third and fourth levels on the Butler lode. Daily tonnage 300 tons, yielding about 27 lb. refined copper to the ton.

ISLE ROYALE (Houghton)—At No. 2 Shaft, will resume sinking to 33rd level in order to continue development of Portage lode. All new openings at this shaft are on the Portage lode, these being on the 24th, 30th and 31st levels. Just reached 18th level at No. 4 shaft.

NEW ARCADIAN (Houghton)—Has commenced milling of its stockpile and the ore held underground; expected to average about 21 lb. Shipping about eight cars daily to Franklin mill. New 18-drill compressor expected about middle of May. At present eight drills are in operation.

MISSOURI

Joplin District

GALENA MINING AND DEVELOPMENT (Galena, Kan.)—Made good strike on lease near Century, Okla. Will build mill.

STANDIFER BROS. (Miami, Okla.)—Obtained lease southeast of Commerce, Okla., and will prospect thoroughly.

WOODCHUCK (Tar River, Okla.)—Recently sold by Commerce Mining & Royalty Co., of Miami, Okla. Details not made public.

G. R. LAMB, of Joplin, reports opening calamine in Oregon County, Mo., on southern state line, about half way between Joplin district and Southeastern Missouri lead district. Two shafts in ore at 50 ft.

KITTY (Tar River, Okla.)—New 350-ton mill in operation on tract near Beaver mine.

MEREDITH & CO. (Joplin)—Strike on lease on Greenback land, immediately north of Quapaw, Okla. Expect to start shaft sinking in near future.

C. M. MITCHELL and associates, of Mountain Grove, Okla., have sold to Tulsa, Okla., men for $50,000 a lease directly north of Blue Mound mine, west of Baxter Springs, Kan.

HIGH FIVE (Webb City)—Will build mill on tract recently developed by drilling in Waco, Mo., field. Ore encountered at 103 ft. and extended to 157. T. F. Coyne and Amos Hatton, of Webb City, interested.

COOPER, PETERS & DAVIS (Joplin)—Will build mill at once on tract north of Chitwood, where recent drilling indicated orebody apparently as rich as any in Oklahoma field. Out of 24 holes put down, several showed cuttings that ran over 50% of blende.

MONTANA

Missoula County

HIDDEN TREASURE (Clinton)—This copper mine, owned by A. M. Stevens, of Missoula, leased to Spokane men, who contemplate shipping soon. May erect mill.

Park County

IN EMIGRANT GULCH, placer operations will be started soon by William Carr, of Spokane, Wash.; same interests operating placers about 20 miles north of Livingston.

Ravalli County

SAN DOY (Florence)—Crosscut tunnel has cut gold vein and winze will be sunk on the ore. Some ore of shipping grade.

Silver Bow County

EAST BUTTE (Butte)—April copper output 2,081,080 lb., a high record, comparing with 1,597,340 lb. in March, 1,460,440 in February and 1,479,520 in January.

ANACONDA (Butte)—April copper output at company's two smelteries was 29,300,000 lb., as against 31,300,000 lb. in March. Decrease chiefly due to closing of several mines, due to fires. Production for last four months 113,850,000 lb., or at rate of 340,000,000 lb. for the year.

NORTH BUTTE (Butte)—Produced in first quarter 8,140,361 lb. copper; silver, 382,286 oz.; gold, 564 oz. Large amount of development work done, opening new bodies of 3 to 6% ore. Total earnings for quarter were $1,063,272, from which dividends were paid amounting to $322,500.

TUOLUMNE (Butte)—April shipments from company mines amounted to 72 cars, of which 51 cars came from Tuolumne mine and 21 from Main Range property. Total shipment about 3600 tons averaging about $12 per ton. New hoisting equipment ordered for Main Range.

BUTTE & SUPERIOR (Butte)—Milled in April 52,700 tons, producing 13,500 tons of 46.8% zinc concentrates, containing 12,420,000 lb. and 250,000 oz. silver. In March milled 50,000 tons, yielding 14,900 tons of 48.7% zinc concentrates, containing 14,500,000 lb. copper; silver output 300,000 oz. In 1916, mined 626,803 tons at average cost of $4.50 per ton.

DAVIS-DALY (Butte)—Net profit for first quarter over $73,000; copper output, 1,126,921 lb.; silver, 63,830 oz. Output steadily increasing. Average of 215 tons copper ore shipped per day, running from 5 to 6% copper and 10 oz. in silver. Shipments of zinc ore to Butte-Detroit mill also increased. Development compaign begun May 3 at Hibernia mine, adjoining Anaconda's Nettie; unwatering of the Nettie has drained 400-ft. Hibernia shaft, which will be sunk to 1000 ft.

NEVADA

Esmeralda County

GOLDFIELD CONSOLIDATED (Goldfield)—Milled in March, 27,000 tons; net realization, $19,728; operating costs, $5.041 per ton. Lessees produced 563 tons, having gross value $9727, company receiving $5995 less transport and milling expense. Development in March, 1453 ft. at expense of $6.73 per ft.

Humboldt County

NENZEL CROWN POINT (Rochester)—In addition to company's 110 acres, the major part of Rochester Elda Fina ground, covering extension of Nenzel Crown Point vein system, has been leased. Bond issue of $300,000 to cover building of 100-ton cyanide mill, and additional unit next year, has been underwritten by R. M. Sanford & Co. of Kansas City, Mo. The 3000-ft. tunnel cut several veins of milling ore at depth of 700 ft., approximately 1000 ft. on dip; tunnel will be continued 1000 ft. to east slope of Nenzel Hill into American Canyon where mill will be constructed at portal. Joseph F. Nenzel, 702 Mutual Savings Bank Building, San Francisco, Calif., president.

Lander County

NICKLAS MINING CO. (Battle Mountain)—Since this gold-silver property came under control of Breitung & Co., a 179-ft. crosscut tunnel

has been driven and vein drifted on for 900 ft.; new workings connected with old at several places. According to H. B. Barling's estimate, ore developed amounts to 98,450 tons averaging $9.55. A 100-ton mill to be built at once. C. B. Dunster, 11 Pine St., New York, manager.

Nye County

TONOPAH ORE PRODUCTION for week ended Apr. 28 was 9646 tons valued at $178,469, compared with 8648 tons for week previous. Producers were: Tonopah Belmont, 2952 tons; Tonopah Extension, 2380; Tonopah Mining, 2300; West End, 796; Jim Butler, 650; Rescue-Eula, 255; Halifax, 138; Cash Boy, 53; miscellaneous, 122 tons.

MORNING GLORY (Manhattan)—Sinking main shaft.

WEST TONOPAH (Tonopah)—Ore reported on 950-ft. level about 750 ft. west of shaft.

UNION AMALGAMATED (Manhattan) — On 600-ft level in south drift from east crosscut face shows three feet of medium-grade ore.

JIM BUTLER (Tonopah)—Net profit for March was $41,412—an increase of about $12,600 over February profit; due to higher grade of ore treated.

MIDWAY (Tonopah)—Winze being sunk on vein from 1300-ft. level. Now down 130 ft. in low-grade quartz showing occasional bunches of ore. Will continue to 200 ft. before crosscutting.

MANHATTAN CONSOLIDATED (Manhattan)—Sinking continues at main shaft with 400-ft. level as objective. Ore from development of upper levels being stored.

TONOPAH EXTENSION (Tonopah)—Net profit for March was $43,322 from 10,671 dry tons ore yielding 1,356.79 oz. gold and 139,498 oz. silver bullion. Water in Victor shaft being held at about 100 ft. below 1540-ft. level.

TONOPAH DIVIDE MINING CO. (Tonopah)—Contract let to William Waters to sink 200-ft. shaft; now down about 25 ft.; hoisting equipment recently installed. Property on Gold Mountain a few miles south of Tonopah. H. C. Brougher, president, recently bought Wingfield interest in this property.

White Pine County

NEVADA CONSOLIDATED (McGill)—Copper production for first quarter, 18,852,321 lb., comparing with 22,898,228 lb. for previous quarter. Milled 940,916 tons, averaging 1.48% copper as against 979,329 tons of 1.63% ore during previous quarter. Of tonnage milled, 72% came from the pits and 28% from underground workings of Ruth mine. Milled also 11,530 tons of Consolidated Coppermines ore. Unusually severe weather curtailed output in early part of quarter.

NEW MEXICO

Grant County

IRON RULE (Mogollon)—H. J. Evans is starting work on this claim in southerly part of district. Lower tunnel to be advanced.

CHINO (Santa Rita)—Copper output in March was 6,200,851 lb. Completion of sixth and seventh section of mill being retarded by delay in machinery deliveries; will give daily capacity of 12,500 tons. The 1000-ton tailing-retreatment plant completed but awaiting power; will ultimately be increased to 5000-ton capacity.

SOCORRO (Mogollon)—At Pacific mine, the 500-ft. level has been advanced 700 ft. north and the 600 has gone 200 ft. in same direction. New vein, carrying copper, gold and silver, has been cut in southerly part of property. All the old ore dump at north end of mine has been sorted, sent to terminal bins of aerial tramway and treated in the Socorro mill; dump at south end now being disposed of. Stoping under way above adit level.

OAKS CO. (Mogollon)—Has increased crew at Maud S. mine; shipping ore to the Socorro mill. At the Deep Down, shaft has been retimbered to creek level, station put in and bulkheads now being completed; shaft will be sunk to 500-ft. level and drifts extended east and west. From this opening the Maud S., Eberle and Clifton will be developed, as the shaft is centrally situated and the several properties are under control of this company.

Luna County

EMPIRE SMELTING AND REFINING (Deming)—This company, which was to blow in its 60-ton lead furnace about May 1, is installing a 20-ton mill to treat ores of steel-hardening metals, especially vanadium and molybdenum.

Taos County

CHIEF CONSOLIDATED (Red River)—Driving development tunnel at property on Goose Creek.

MEMPHIS RED RIVER (Red River)—Operating its new flotation mill on the Red River, just below town, with satisfactory results.

BUFFALO NEW MEXICO MINES CO. (Red River)—Working three shifts in development tunnel on Pioneer Creek. Sixteen men employed. Richard Kelly, superintendent.

CARIBEL MINING AND MILLING CO. (Red River)—Caribel vein cut recently 100 ft. above tunnel level. A 60-ft. raise will be driven on vein to connect with upper workings. Crew will be increased as fast as good men are available. Marked shortage of labor, especially of hand miners.

OREGON

Baker County

HOMESTEAD-IRON DYKE MINES CO. (Homestead)—Important copper orebody opened by the shaft at a point 300 ft. below tunnel level or 800 ft. below outcrop of main orebody.

PENNSYLVANIA

Montgomery County

SCHWENKSVILLE METALS AND MINING CO. (Schwenksville)—This old copper mine, first worked in 1734—by the British—and again in 1900 and 1907, was reopened by this company in 1916 to find the faulted vein. A 3-ft. vein opened and small mill may be erected. C. Minieri, manager. Has also reopened the old zinc-lead mine near Phoenixville; cleaning out the two old shafts; has already recovered about 20 tons of ore said to assay 37% zinc and 23% lead.

UTAH

Beaver County

MONTREAL (Milford)—Shipping over 100 tons of 2 to 3% copper ore daily. Railroad spur is to be built to property, and with better shipping facilities, expects to add to output.

PALOMA (Milford)—Copper ore of good grade opened on 855-ft. level. Two cars shipped recently from 600 and 700 levels. Shaft to be continued to 900 ft. before starting much development.

Juab County

TINTIC SHIPMENTS for April amount to 887 cars, estimated at 44,350 tons, and valued at $1,100,000, an unusually heavy tonnage for a period of four shipping weeks. In March—five weeks—1043 cars were shipped; in February, 737 cars, and in January, 802 cars.

EUREKA MINES (Eureka)—Third car of ore from 1250 level being prepared for market. First car brought $1000; second, $1500. Ore reported on 1300 level.

TINTIC STANDARD (Eureka)—First quarter 1917 shows $34,801 cash on hand Mar. 31, 1917. Produced during period 2420 tons of ore, which sold for $62,481; net returns, $40,894. Cash on hand, Dec. 31, 1916, was $20,000.

MAMMOTH (Mammoth)—Dividends of 5c. a share or $20,000 to be paid May 12, bringing total to $2,440,000. April shipments were 81 cars; March, 72; February, 28; and January, 59. During 1916, 732 cars of ore shipped.

Millard County

SILVER TIP MINING (Delta)—Engineer will be sent early in May to plan systematic development of this silver-copper property. Head office, 1326 Washington Bldg., Los Angeles, Calif.

Piute County

MINERAL PRODUCTS CO. (Marysvale)—State report, recently filed, shows net proceeds of $70,488 last year; gross income, $610,266; expenditures, $539,782. Potash production, 2772.38 tons.

Salt Lake County

BINGHAM COALITION (Bingham)—Half the working force taken off owing to damage from recent flood.

SELLS (Alta)—Concentrating on development with view to shipment when roads permit. Three cars of ore in bins.

EMMA CONSOLIDATED (Alta)—Management reports shipments from Jan. 11 to Apr. 7—made intermittently owing to condition of roads—to have amounted to 33 cars or 1164 tons, net smelter returns from which were $35,391.

Summit County

PARK CITY SHIPMENTS during April were 7783 tons of ore and concentrates. The Judge Mining and Smelting, with much increased output, heads the list with 2319 tons.

CALIFORNIA-COMSTOCK (Park City)—California tunnel being retimbered, as well as raise from tunnel to level 60 ft. above, where there is good ore. Cessation of operations—at present being resumed—occurred at time when metal prices were low and complex ores penalized more than at present. New electrical equipment being installed.

Tooele County

QUEEN OF THE HILLS (Stockton)—Fifth dividend, $3000 or 3c. a share, announced; royalty paid by Big Four company lessees.

WESTERN UTAH COPPER (Gold Hill)—Production of this Deep Creek property increased to 200 tons a day, with expectation of further increase.

WASHINGTON

Stevens County

LOON LAKE COPPER (Loon Lake)—Crosscut on 300-ft. level disclosed 12 ft. of shipping ore. Now drifting east on vein.

YOUNG AMERICA (Bossburg)—This mine reopened and shipment of zinc-lead ore recently sent to Northport smeltery.

QUEEN CONSOLIDATED MINING (Colville)—This company, backed by Fall River, Mass., men, has opened lead-silver-copper ore in 500-ft. tunnel in the Chloride Queen group of five claims on Clugston Creek, 14 miles north. Water power available. Mill contemplated; company desires machinery catalogs.

CANADA

British Columbia

DOLLY VARDEN MINES CO. (Alice Arm)—Contract let for construction of 18-mile narrow-gage railway from Alice Arm to mine along government trail on Kibsault River; to be completed by fall when company will start construction of mill; R. B. McGinnis, manager. Several prospects in district have disclosed good ore.

DONOHOE MINES CORPORATION (Quilchena)—Now shipping concentrates by motor truck to railroad, 24 miles; some crude also shipped. Joshua shaft, 420 ft. deep; four levels opened. Tubal Cain shaft 216 ft. deep; two adits being driven at 400 and 600 ft. King William shaft 175 ft. deep, with drifts at 50 and 100 ft. Frank M. Hawkes, manager.

MANITOBA

MANDY MINING (The Pas)—Company has hauled 3600 tons 40 miles to Sturgeon Lake, where it is awaiting open water for further shipment.

Ontario

McRAE (Porcupine)—Shaft unwatered and equipment ready for sinking.

APEX (Porcupine)—A 9-ft. vein encountered in diamond drilling at depth of 890 ft.

KIRKLAND LAKE (Kirkland Lake)—The vein encountered at 600-ft. level; shaft will be deepened.

NORTH THOMPSON (Porcupine)—Main vein, cut at 600-ft. level, shows width of 20 ft. of good ore.

KIRKLAND LA BELLE (Kirkland Lake)—Diamond drilling has proved existence of ore-bodies to depth of 700 ft.

NEWRAY (Porcupine)—New vein crosscut on 400-ft. level 460 ft. from shaft; crosscut for 15 ft. without reaching hanging wall.

BOSTON CREEK (Boston Creek)—Winze sunk from 300-ft. level now down 100 ft.; at bottom vein is 4 ft. wide, with 7 in. of high-grade and the rest good milling ore.

DAVIDSON (Porcupine)—Difficulties, caused by flow of water in drill hole below 200-ft. level, resulting in suspension of operations for a week, overcome by additional pump.

McKINLEY-DARRAGH (Cobalt) — Foundation for new 200-ton flotation mill begun, the site being on lake shore close to railway. Regrinding will be done in a Marathon mill and a dragline excavator will convey the tailings from lake bed to mill.

MEXICO

GREENE-CANANEA (Cananea, Son.)—April copper output, 4,730,000 lb.; silver, 135,880 oz.; gold, 750 oz. March copper production, 5,500,000 lb.; February, 5,100,000; January, 5,700,000 pound.

CHILE

BRADEN (Sewell)—Blister copper made in April amounted to 5,102,000 lb.

COLOMBIA

NECHI MINES, LTD. (Zaragoza)—Gross returns Feb. 20 to Apr. 14 $29,932 from 76,589 cu.yd. or about 39c. per cu.yd.

PERU

CERRO DE PASCO (La Fundicion)—April copper output estimated at 5,936,000 lb. comparing with 6,074,000 lb. in March.

NORWAY

A/S KRISTIANSSANDS NIKKELRAFFINERINGSVERK (Christiansand)—Cable dispatches announce destruction, on May 6, by fire of this important nickel-refining works. Output was said to have been under contract to Germany since before the war.

BELGIAN CONGO

UNION MINIERE DU HAUT KATANGA (Lubumbashi)—April copper output, 5,070,580 lb., comparing with 5,996,510 lb. in March.

AUSTRALIA

MOUNT MORGAN (Mount Morgan, Queensland)—Production for four weeks ended Apr. 1 was 621 tons of blister copper containing 612 tons of fine copper and 8841 oz. gold. First Hancock jig installed to reduce silica in furnace charge; test indicates possibility of producing convertible grade of matte in one operation.

CHOSEN

ORIENTAL CONSOLIDATED (Unsan)—April cleanup, cable estimate, $125,000. March results from various mills were: Tabowie, $36,042; Taracol, $29,891; Maibong, $21,891; Taracol cyanide plant, $55,460; Maibong tube mill bullion, $4416; total, $147,704 from 26,883 tons. Bullion shipped by insured parcel post to Osaka, Japan, in 90 small bars; insurance company has arranged with police department for escort of postman, relieving mining company of this burden. February net profits, $46,830.

The Market Report

Metal Markets

SILVER AND STERLING EXCHANGE

May	Sterling Exchange	Silver New York, Cents	Silver London, Pence	May	Sterling, Exchange	Silver New York, Cents	Silver London, Pence
3	4.7556	75⅛	38⅛	7	4.7556	74⅜	37 15/16
4	4.7556	75⅛	38⅛	8	4.7556	74⅜	37 15/16
5	4.7556	74⅜	38	9	4.7556	74⅜	37 15/16

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

May	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
	27½		9½	9½	9½
3	@28½	58¼	@10	@10	@9½
	28		9½	9½	9.10
4	@29	58¼	@10	@10	@9.20
	28½		9½	9½	9.00
5	@29	58⅛	@10⅛	@10⅛	@9.10
	28½		9⅛	9⅛	9.00
7	@29¼	58⅛	@10⅛	@10⅛	@9.10
	28½		9⅛	9⅛	
8	@29	59⅛	@10⅛	@10⅛	9.00
	28½		9⅛	9⅛	
9	@29½	63½	@10¼	@10¼	9.00

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes; ingots and wirebars. Electrolytic copper is commonly sold on "regular terms" (r.t.), including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 17c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

May	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
3	130	129½	142	229½	230¼	30½	54
4	130	129½	142	231	231½	30½	54
5							
7	130	129½	142	232	232½	30½	54
8	130	129½	142	232½	233	30½	54
9	130	129½	142	234½	235	30½	54

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅛c.

NEW YORK—May 9, 1917

All of the metal markets were very interesting this week and all were active except zinc. Copper, lead and tin rose sharply.

Wednesday, May 30, being a holiday, the Journal for the week ending June 2 will go to press on May 29 and quotations of the metal market will be for the five days May 24-29 inclusive.

Copper, Tin, Lead and Zinc

Copper—A buying movement began last week, as we reported, and continued on a moderate scale through Thursday of this week, sales being made on that day at a further advance in price. On Friday morning some large orders were placed by brass manufacturers, at prices beginning at 28c. and closing at 29c. for third-quarter delivery. Upward of 20 million pounds were sold on this day by several producers. The business continued on a fair scale during Monday, Tuesday and Wednesday, and the total sales for the week were apparently in the neighborhood of 50 million pounds. On Tuesday a round lot, respecting which the buyer asked terms from several producers, was taken by one of them at a cut price, but on Wednesday, round lots were sold at an advance.

The buyers of the week were principally brass makers, but wire drawers and sheet rollers were also in the market. The transactions were numerous, the lots that were taken ranging from half a million to three million pounds in the main. Practically all of this business was for third-quarter delivery, which is now the major and competitive market. There were some sales of fourth-quarter copper at very material reductions in price. Some trifling sales of near-by copper were made at premiums. At the close, May was about 30½@31c., June 30@30½c., and July, 29½@30c.

There were several other interesting and curious features during the week. The best grades of casting copper were sold at the same prices as electrolytic. The business in electrolytic was not shared by all of the selling agencies, although some of them reported that they had offered copper at less than the prices that were actually paid.

Copper Sheets—The price of copper sheets remains the same as shown by our quotation last week. We quote hot rolled at 40@42c. per lb. cold rolled 1c. higher. Wire is now quoted 36@38c., f.o.b. mill.

Tin—A large business was done during every day of the week, averaging probably as much as 200 tons per day. On Wednesday, after the report had been read in the morning papers to the effect that Congress would put a 10% duty on tin, the market advanced sharply, opening at 63c., and closing at 64c. A large business was done on this day.

Lead—The report that we published last week to the effect that the requirements of both Army and Navy in May and June would not exceed 2500 tons failed to relieve the tension in this market. On Friday, a large consumer who needed 500 tons of May lead was able to get only 300 and had to pay 10c. for it. Apart from this, the largest orders of the week were placed by ammunition manufacturers. Otherwise, business of the week was mostly in small lots, as high as 10½c. being paid for June lead. The aggregate sales of the week, reported to us, were about 2600 tons, but if the few large orders were deducted, the total would be much smaller. The tendency of buyers to bid up prices against themselves is deprecated by the large producers, who foresee that continued extravagance in this market will restrict consumption to the later disadvantage of everybody. At the close, a slightly easier tendency was discernible, June lead being offered at 10¼c. and July sold at 10c.

Zinc—There was not much interest in this metal, transactions being light. There was some buying by dealers. Toward the close of the week, the market settled to the basis of 9c., irrespective of time of delivery, this being the normal condition of a market with stocks on hand.

Zinc Sheets—Price of zinc sheets has not been changed. Market is still at $19 per 100 lb. f.o.b. Peru., Ill., less 8% discount.

Other Metals

Aluminum—The aluminum market remains quiet and somewhat duller than last week. No demand has developed. Nominal quotation is 59@60c. per lb. for No. 1 ingots, New York.

Antimony—Owing to unexpected supplies offered, some brought by express from the Pacific coast, the price dropped to 25c. on Saturday, and although there are no fundamental changes from last week's conditions, today the market is weak and quoted at 23c.@24. May-June shipment from China is quoted at 14¾@16c., c.i.f. New York, duty unpaid.

Nickel—The market remains steady at 50@55c. per lb. for nickel. Electrolytic commands an additional 5c. per lb.

Quicksilver—Market unchanged at $113. San Francisco reports by telegraph, $112, steady.

Gold, Silver and Platinum

Gold—The Bank of England gold reserve, according to a report from Samuel Montagu & Co., London, Apr. 19, 1917, showed an increase of £124,520, as compared with the previous week.

Silver—The market has remained fairly steady the past week, price fluctuating between 38⅛ and 37 15/16 pence in London. Supplies continue moderate and the demand for coinage continues so that outlook is for a steady market. The U. S. Mint purchased 250,000 oz. on May 7 at prices ranging from 75¼ to 77¾.

The Indian currency reserve for Apr. 15, according to a report from Samuel Montagu & Co., London, showed a reduction of 62 lacs in the holding of silver, although the total of the note issue had increased by 37 lacs. The stock in Bombay consisted of 1700 lacs. Stock in Shanghai on Apr. 14 consisted of about 28,000,000 oz. in sycee and 16,400,000 dollars.

Mexican dollars, at New York, May 3, 57⅝c.; 4, 58c.; 5, 57¾c.; 7, 58c.; 8, 57¾c.; 9, 57¾c.

Platinum—Unchanged and steady at $105.

Our Petrograd correspondent reports under date of Mar. 3, 1917, that all business has ceased and there is no change in price. From Ekaterinburg it is reported that the output of the small producers, tributors, has sensibly decreased. It is the general opinion that with the trade unrestricted by the government, a sharp increase of prices will ensue.

Palladium—The improvement in demand, reported last week, continued. In the early part of the week sales were made at $100, and in the latter part at close to $105. We quote $100@105 for the week.

Zinc and Lead Ore Markets

Platteville, Wis., May 5—Blende, basis 60% Zn, $72.50 for premium ore down to $65 for medium grade. Lead ore, basis 80% Pb, $115 per ton. Shipments reported for the week are 2472 tons of zinc ore, 40 tons of lead ore, and 544 tons of sulphur ore. For the year to date the figures are: 46,492 tons of zinc ore, 1715 tons of lead ore, and 9069 tons of sulphur ore. Shipped during the week to separating plants, 3414 tons of zinc ore. The market was somewhat stronger at the week end. A number of operators are disinclined to sell at present prices and a surplus is accumulating in bins. Output is curtailed, on the other hand, by shortage of labor.

Joplin, Mo., May 5—Blende per ton, high, $76.90; basis 60% Zn; premium ore, $75; medium to low $74@68; calamine, per ton, basis 40% Zn, $40; average selling price, all grades of zinc, $64.30 per ton.

Lead, high $117.90; basis 80% Pb, $115@110; average selling price, all grades of lead, $113.63 per ton.

Shipments the week: Blende, 7053 tons; calamine,1225 tons; lead, 1674 tons. Value, all ores the week, $722,520. Increase over last year, blende, 20,725 tons; calamine, 2811 tons; lead, 5951 tons.

The figures secured by the Southwest Mine Safety and Sanitation Association, from its members, have not been made public locally, but a committee is East, laying the cost before proper authorities hoping to find relief from government sources. An estimate was permitted to be used to the effect that 25% of the mines in the sheet-ground area could not produce on a $70 base price for blende, that 50% would require $75 base and 25% an $80 base. It was hoped a revised statement would be given out, but the committee hastened East without giving authority for further statement of mining costs, based on the present high prices of supplies.

Other Ores

Manganese Ore—Being in urgent demand, market has been bid up by buyers. Carnegie schedule has been raised to $1 per unit for 49% ore. Chemical ore is unchanged at 4½@6c. per lb., according to grade.

Molybdenum Ore—Molybdenite quoted at $3.33 per lb. of molybdenum content.

Tungsten Ore—We quote $18½@19½ for the week.

Under date of May 8, Charles Hardy reports as follows: "The foreign business referred to in my last report has been placed during the past week and has further helped to eliminate from our market quite a tonnage of ore, again reducing our Eastern stock to an absolute minimum. No high-grade ore of any kind is to be had in quantities. Shipments from the West are delayed on account of difficulties in securing railroad cars and though quite a number of manufacturers have contracted for ore at comparatively low prices, they are now forced to come into the open market and this has accentuated the position to such an extent that I understand high-grade ore has been paid at the

new schedule prices, though some ore in the New York district has still been sold during the past week at prices ranging from $18.50 to $19. France and Italy are still seeking offers for ore and ferro-tungsten and though a quantity was placed last week by both, new business is pending, but delayed on account of cable communications being very difficult just now. The moment the few lots of tungsten ore now in the East and contracted prior to the rise, have been disposed of, the schedule prices will undoubtedly be paid and prompt delivery might even obtain a premium over these prices.

Other Minerals

Barite—Bleached white, 1¼c. per lb.; off color, $14 per net ton. Blanc fixe advanced to 4½c. per lb.[1]

Magnesite—Calcined (85% oxide) 3¼c. for futures and 3½c. per lb. for spot. Dead burned, 3c.; raw carbonate, 1¼c. for future Californian and 2¼c. per lb. for spot Grecian.[1]

Monazite—Spot Brazilian per arrival May 15, $55 per unit of ThO_2 per net ton of sand.[1]

Zirkite—Natural oxide, 80% oxide, firm at 6c. per lb.; cement (200 mesh) 8c. per lb. for spot delivery in large lots.[1]

Iron Trade Review

NEW YORK—May 9

The hysterical reports from Washington of a $1,000,000,000 outlay for an American Merchant fleet, says "Iron Age," the "diversion to Government uses of the products of every steel mill in the country" and the cancellation of existing contracts between the mills and private buyers have given some concern to manufacturing consumers. The fact is that no such drastic action has been determined upon and it is not improbable that the needs of the Shipping Board will be met voluntarily by the steel trade.

PITTSBURGH—May 8

The National Tube Co. has decided not to follow the advance of six points or about $12 a ton, announced as effective May 1 by the independent pipe mills, and has therefore necessarily withdrawn from the market, very well sold up indeed. The wire and sheet and tin plate subsidiaries of the Steel Corporation had previously withdrawn and the Carnegie Steel Co. is selling only in exceptional cases. As the Western and Alabama subsidiaries are doubtless in somewhat the same position the Steel Corporation's activity in the market is very limited indeed. It is sold for an average of 10 months ahead.

The Government continues to place allotments of steel as fast as the specifications can be drawn up, latest orders being largely for sheets. The total placed to date probably exceeds 700,000 tons of all-steel products, with 300,000 to 400,000 tons to come in the near future, for the Government's own requirements. Then purchases for the European Allies will be undertaken, probably chiefly in shell steel, and this tonnage may run still larger. Price concessions somewhat smaller than on Government steel are expected for these later purchases.

Early deliveries are desired on the bulk of steel thus far bought, and the steel mills are to classify their present tonnage obligations so that the authorities may indicate where the necessary postponements in deliveries are to be made.

While there is strong pressure from some buyers to place additional orders the total volume of steel business, apart from Government buying, promises to be comparatively light in future. The independents are advancing prices rather sharply in some directions. The Government is buying many relatively minor articles for which it cannot conveniently buy the steel direct, and if market conditions interfere with the satisfactory filling of these orders Government steel price regulation may be forced. At present this does not seem to be expected.

Pig Iron—The production of pig iron has probably increased to above 41,000,000 tons a year, the best rate on record barring that of last October, yet pig iron seems to grow scarcer and prices show an advancing tendency. One large seller of bessemer and basic iron has practically withdrawn from the market and this may bring about further advances within a few days, as there is considerable enquiry for both grades. Last sales reported are at $40, valley, for basic, and $44 for bessemer, an advance in the latter of $1 a ton since last report. The $40 price on foundry and malleable has disappeared, except for first half 1918, sales being readily made for this year at $42, valley, an advance of $2 since last report.

Steel—Billets and sheet bars have lately been quotable at $90@85 for either, but lately the sheet mills, which are very short of steel and therefore have idle capacity, have been ready to take conversion contracts, the sheet consumer to furnish the sheet bars, and this has led to relatively heavy buying. A fortnight or so ago the Ford Motor Co. made large purchases at $80, but last week $85 was paid by another sheet consumer, for 3500 tons, and since then there have been sales at $90.

[1]Quotation supplied by Foote Mineral Co., Philadelphia.

STOCK QUOTATIONS

N. Y. EXCH.†	May 8
Alaska Gold M.	6⅛
Alaska Juneau	5½
Am. Sm. & Ref., com.	98⅛
Am. Sm. & Ref., pf.	112⅛
Am. Sm. Sec., pf. A	97⅛
Am. Sm. Sec., pf. B	92
Am. Zinc	30⅛
Am. Zinc, pf.	63⅛
Anaconda	78⅛
Batopilas Min.	1½
Bethlehem Steel	127
Bethlehem Steel, pf.	120
Butte & Superior	42⅛
Cerro de Pasco	34
Chile Cop.	21⅛
Chino	52⅛
Colo. Fuel & Iron	46⅛
Crucible Steel	61
Dome Mines	13
Federal M. & S.	11½
Federal M. & S., pf.	38
Great Nor., ore ctf.	30⅛
Greene Cananea	43½
Homestake	‡114
Inspiration Con.	55⅛
International Nickel	41
Kennecott	44½
Lackawanna Steel	82⅛
Miami Copper	39
Nat'l Lead, com.	53½
National Lead, pf.	104
Nev. Consol	23½
Ontario Min.	5½
Quicksilver	2
Quicksilver, pf.	1½
Ray Con.	29⅛
Republic I. & S., com.	78⅛
Republic I. & S. pf.	102
Sloss-Sheffield	‡50
Tennessee C. & C.	15⅛
U. S. Steel, com.	114⅛
U. S. Steel, pf.	117⅞
Utah Copper	113⅛
Va. Iron C. & C.	62

N. Y. CURB†	May 8
Big Ledge	3
Butte & N. Y.	1½
Butte C. & Z.	11
Caledonia	.63
Calumet & Jerome	1 1/16
Can. Cop. Corpn.	1½
Carlisle	5½
Con. Ariz. Sm.	2 3/16
Con. Coppermines	4½
Con. Nev.-Utah	1/16
Emma Con.	1 1/16
First Nat. Cop.	2½
Goldfield Con.	.51
Goldfield Merger	.05
Greenmonster	1½
Hecla Min.	7½
Howe Sound	5½
Jerome Verde	1 11/16
Joplin Ore & Spel.	.20
Kerr Lake	4½
Magma	46
Majestic	.41
McKinley-Dar-Sa.	.50
Mohican	1/16
Mother Lode	.28
N. Y. & Hond.	‡14
Nipissing Mines	7⅛
Ohio Cop.	1 1/16
Ray Hercules	3½
Rochester Mines	.70
St. Joseph Lead	18
Seneca	‡11
Standard S. L.	1/16
Stewart	.28⅛
Success	.39
Tonopah	6⅛
Tonopah Ex.	2⅛
Tribullion	.25
Troy Arizona	.38
United Verde Ext.	37
United Zinc	4½
White Knob, pf.	1½
White Oaks	2
Yukon Gold	1½

SAN FRAN.*	May 8
Alta	.03
Andes	.17
Best & Belcher	.06
Bullion	.02
Caledonia	.18
Challenge Con.	.05
Confidence	.13
Con. Virginia	.73
Gould & Curry	.04
Hale & Norcross	.05
Jacket-Cr. Pt.	.06
Mexican	.23
Occidental	.65
Ophir	.11
Overman	.03
Savage	.07
Seg Belcher	.02
Sierra Nevada	.18
Union Con.	.40
Utah Con.	.01
Belmont	4.00
Jim Butler	.72
MacNamara	.10
Midway	.15
Mont.-Tonopah	.19
North Star	.12
Rescue Eula	.28
West End Con.	.65
Atlanta	.10
Booth	.07
Comb. Frac.	.04
D'field Daisy	.03
Florence	.20
Jumbo Extension	.43
Kewanas	.13
Nevada Packard	.38
Round Mountain	.34
Silver Pick	.12
White Caps	1.40
Argo	‡.05
Ariz. Central	‡.10
Big Jim	.76
Lay Boy	‡.06
Neille	‡.16
Tom Reed	‡2.00
United Eastern	4.25

BOSTON EXCH.*	May 8
Adventure	2½
Ahmeek	.96
Algomah	.50
Allouez	60½
Ariz. Com., ctfs.	12½
Arnold	.40
Bonanza	.20
Butte-Ballaklava	.90
Calumet & Ariz.	.78
Calumet & Hecla	5.35
Centennial	.18
Copper Range	60⅛
Daly West	1½
Davis-Daly	4½
East Butte	12
Franklin	6⅛
Granby	78
Hancock	14
Hedley	1.5
Helvetia	.25
Indiana	2½
Island Cr'k, com.	65
Isle Royale	29
Keweenaw	2½
Lake	11½
La Salle	3½
Mason Valley	5½
Mass	11½
Mayflower	1½
Michigan	3
Mohawk	84½
New Arcadian	3½
New Idria	15
North Butte	21½
North Lake	1½
Ojibway	1½
Old Colony	2
Old Dominion	57½
Osceola	83½
Quincy	83½
St. Mary's M. L.	78
Santa Fe	1
Shannon	7
Shattuck-Ariz.	24½
So. Lake	3½
So. Utah	.18
Superior	9½
Superior & Bost.	4½
Trinity	3½
Tuolumne	1½
U. S. Smelting	53½
U. S. Smelt'g, pf.	49½
Utah Apex	2
Utah Con.	14½
Utah Metal	4½
Victoria	3½
Winona	3
Wolverine	40½
Wyandot	87

BOSTON CURB*	May 8
Alaska Mines Corp.	1½
Bingham Mines	10½
Boston Ely	‡.65
Boston & Mont.	.65
Butte & Lon'n Dev.	.23
Calaveras	3½
Calumet-Corbin	.01
Chief Con.	2½
Cortez	.20
Crown Reserve	.33
Crystal Cop	.87
Eagle & Blue Bell	2½
Houghton Copper	.90
Intermountain	1 1/16
Iron Cap Cop., pf.	14½
Mexican Metals	.27
Mines of America	1½
Mojave Tungsten	.42
Nat. Zinc & Lead	.50
Nevada-Douglas	1½
New Baltic	1½
New Cornelia	16½
Oneco	.50
Pacific Mines	‡.25
Rex Cons	.30

SALT LAKE*	May 8
Bannack	1.15
Big Four	.70
Black Jack	.06
Cardiff	5.50
Colorado Mining	.18
Crown Point	‡.05
Daly-Judge	‡.50
Empire Copper	1.25
Gold Chain	.11
Grand Central	.45
Iron Blossom	.97
Lower Mammoth	‡.03
May Day	.08
Moscow	‡.12
Prince Con.	1.20
Silver-King Coal'n	2.95
Silver King Con.	3.82½
Sioux Con.	.10
So. Hecla	1.15
Uncle Sam	.03
Wilbert	.11
Yankee	11½

TORONTO*	May 8
Bailey	.03
Beaver Con.	.33
Buffalo Mines	1.20
Chambers Ferland	.09
Coniagas	3.60
La Rose	.44
Peterson Lake	.09
Right of Way	.04½
T. & Hudson Bay	40.00
Temiskaming	.38
Wettlaufer-Lor.	.05
Dome Exten.	.19
Dome Lake	.19
Foley O'Brien	.60
Hollinger	4.95
Jupiter	.28
McIntyre	1.64
Newray	1.47
Porcu. Crown	.57
Schumacher	.49
Vipond	.39
West Dome	.23

STOCK QUOTATIONS—Continued

COLO. SPRINGS	May 8
Cresson Con.	5.81½
Doctor Jack Pot.	.06½
Elkton Con.	.07¼
El Paso	.28
Gold Sovereign	.04
Golden Cycle	2.20
Granite	.54
Isabella	.13
Mary McKinney	.24
Portland	1.53
United Gold M.	.17
Vindicator	.67

LONDON	Apr. 21
Alaska Mexican	£0 12s 6d
Alaska Tre'dwell	2 15 0
Burma Corp.	3 6 10½
Cam & Motor	0 9 0
Camp Bird	0 7 6
El Oro	0 9 3
Esperanza	0 9 6
Mexico Mines	4 2 6
Nechi, pfd.	0 14 3
Oroville	0 15 6
Santa Ger't'dis	0 10 6
Tomboy	0 19 6

* Bid prices. † Closing prices. ‡ Last Quotations.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1915	1916	1917	1915	1916	1917
January	48.855	56.775	75.630	22.731	26.960	36.682
February	48.477	56.755	77.585	22.753	26.975	37.742
March	50.241	57.935	73.861	23.708	27.597	36.410
April	50.250	64.415	73.875	23.709	30.662	36.963
May	49.915	74.269		23.570	35.477	
June	49.034	65.024		23.267	31.060	
July	47.519	62.940		22.597	30.000	
August	47.163	66.083		22.780	31.498	
September	48.680	68.515		23.591	32.584	
October	49.385	67.855		23.925	32.361	
November	51.714	71.604		25.094	34.192	
December	54.971	75.765		26.373	36.410	
Year	49.684	65.661		23.675	31.315	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1916	1917	1916	1917	1916	1917
Jan.	24.008	28.673	88.083	131.921	116.167	142.895
Feb.	26.440	31.750	102.667	137.895	133.167	148.100
Mar.	26.310	31.481	107.714	136.750	136.000	151.000
April	27.895	27.935	124.319	133.842	137.389	147.158
May	28.625		135.457		152.522	
June	26.601		112.432		137.455	
July	23.865		95.119		125.500	
Aug.	26.120		110.283		126.304	
Sept.	26.855		113.905		134.071	
Oct.	27.193		122.750		142.523	
Nov.	30.625		134.659		155.432	
Dec.	31.890		145.316		162.842	
Year	27.202		116.059		138.281	

Tin	New York		London	
	1916	1917	1916	1917
January	41.825	44.175	175.548	185.813
February	42.717	51.420	181.107	198.974
March	50.741	54.388	193.609	207.443
March	51.230	55.910	199.736	220.171
May	49.125		196.511	
June	42.231		179.466	
July	38.510		168.357	
August	38.565		169.870	
September	38.830		171.345	
October	41.241		179.307	
November	44.109		186.932	
December	42.635		183.368	
Av. year	43.480		182.096	

Lead	New York		St. Louis		London	
	1916	1917	1916	1917	1916	1917
January	5.921	7.626	5.826	7.530	31.167	30.500
February	6.246	8.636	6.164	8.595	31.988	30.500
March	7.136	9.199	7.375	9.120	34.440	30.500
April	7.630	9.288	7.655	9.158	34.368	30.500
May	7.463		7.332		32.967	
June	6.936		6.749		31.011	
July	6.352		6.185		28.137	
August	6.244		6.088		29.734	
September	6.810		6.699		30.786	
October	7.000		6.898		30.716	
November	7.042		6.945		30.500	
December	7.513		7.405		30.500	
Year	6.858		6.777		31.359	

Spelter	New York		St. Louis		London	
	1916	1917	1916	1917	1916	1917
Jan.	16.915	9.619	16.745	9.449	89.810	48.329
Feb.	18.420	10.045	18.260	9.875	97.762	47.000
Mar.	16.846	10.300	16.676	10.130	95.048	47.000
April	16.695	9.459	16.525	9.289	99.056	54.632
May	14.276		14.106		94.217	
June	11.752		11.582		68.591	
July	8.925		8.755		50.750	
Aug.	8.730		8.560		51.587	
Sept.	8.990		8.820		52.095	
Oct.	9.829		9.659		54.159	
Nov.	11.592		11.422		56.023	
Dec.	10.665		10.495		55.842	
Year	12.804		12.634		72.071	

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. ‡ Not reported.

Pig Iron, Pitts.	Bessemer‡		Basic‡		No. 2 Foundry	
	1916	1917	1916	1917	1916	1917
January	$21.60	$35.95	$18.78	$30.95	$19.70	$30.95
February	21.16	36.37	18.93	30.95	19.51	30.95
March	21.81	37.37	19.20	33.49	19.45	35.91
April	21.65	42.23	18.95	38.90	19.45	40.06
May	21.78		19.11		19.58	
June	21.95		18.95		19.34	
July	21.95		18.95		19.20	
August	21.95		18.95		19.22	
September	22.88		19.58		19.53	
October	24.61		21.26		21.51	
November	30.07		28.18		26.55	
December	35.16		30.95		30.79	
Year	$23.88		$20.98		$21.15	

‡ As reported by W. P. Snyder & Co.

Current Prices—Materials and Supplies

IRON AND STEEL

Drill Steel—New York price in cents per pound is:

Solid ..... 10@12 Hollow ..... 22@24

Structural Material—The following are the base prices f.o.b. mill, Pittsburgh, together with the quotations per 100 lb. from warehouses at the places named:

	Pittsburgh	New York May 9, 1917	New York One Year Ago	Chicago	San Francisco	Dallas
Beams, 3 to 15 in.	$3.80	$4.75	$3.30	$4.75	$6.25	$5.25
Channels, 3 to 15 in.	3.80	4.75	3.30	4.75	6.25	5.25
Angles, 3 to 6 in., ¼ in. thick	3.80	4.75	3.30	4.75	7.15	5.25
Tees, 3 in. and larger	3.80	4.80	3.35	4.80	6.25	5.25
Plates	5.50	6.50	4.25	6.00	8.50	7.50

New York extras on other shapes and sizes per lb. are as follows:

I-beams over 15 in.	$0.10
Angles over 6 in., on one or both legs	.10
Angles, 3 in. on one or both legs less than ¼ in. thick	.70
Cutting to lengths, under 3 ft. to 2 ft inclusive	.25
Cutting to lengths, under 2 ft. to 1 ft. inclusive	.50
Cutting to lengths, under 1 ft.	1.55

No charge is made for cutting to lengths 3 ft. and over.

Sheets—Quotations are in cents per pound in various cities from warehouse, also the base quotation from mill:

Blue Annealed	Large Lots, Pittsburgh	Chicago	San Francisco	New York May 9, 1917	New York One Mo. Ago
No. 10	...	6.25	7.25	7.50	6.00
No. 12	...	6.30	7.30	7.50	6.05
No. 14	...	6.35	7.35	7.20	6.19
No. 16	...	6.40	7.40	7.20	...
Black					
Nos. 18 and 20	...	6.80	7.45	7.80	6.30
Nos. 22 and 24	...	6.85	7.55	7.85	6.35
No. 26	...	6.90	7.65	7.90	6.40
No. 27	...	6.95	7.75	7.95	6.45
No. 28	...	7.00	7.85	8.00	6.50
Galvanized					
No. 10	6.75	8.20	...	8.70	7.10
No. 12	6.80	8.20	8.46	8.85	7.15
No. 14	6.85	8.20	8.46	9.00	7.20
Nos. 18 and 20	7.20	8.40	8.76	9.15	7.50
Nos. 22 and 24	7.30	8.55	8.90	9.30	7.70
No. 26	7.45	8.70	9.05	9.45	7.95
No. 27	7.50	8.85	9.20	...	8.10
No. 28	7.75	9.00	9.39	9.75	8.25

Note—Black sheets very scarce.

Corrugated Sheets—Prices of corrugated sheets (2½-in. corrugations) in cents per pound in jobbers' warehouses in New York and Chicago:

Gage	Black New York	Black Chicago	Galvanized New York	Galvanized Chicago	Lb. per 100 Sq.Ft. Black	Lb. per 100 Sq.Ft. Galvanized
No. 22	7.85	7.35	9.30	8.90	136	151
No. 24	7.85	7.35	9.30	8.90	110	124
No. 26	7.90	7.45	9.45	9.10	83	98
No. 28	8.00	7.55	9.75	9.40	68	85

Steel Rails—The following quotations are per 100 lb. f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh	Chicago
Standard bessemer rails	$38.00	$38.00
Standard openhearth rails	40.00	40.00
Light rails, 8 to 10 lb.	63.00	63.00
Light rails, 12 to 14 lb.	61.00	61.00
Light rails, 25 to 45 lb	60.00	60.00

Track Supplies—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh	Chicago	San Francisco
Standard railroad spikes	$3.85	$4.10	$5.00
Track bolts	5.45	5.10	6.00
Standard section angle bars	2.75	2.75	4.35

Wire Rope—Discounts from list price on regular grades of bright and galvanized are as follows:

	New York May 9, 1917	New York One Year Ago	St. Louis	Chicago	Dallas
Galvanized	15-2½%	25-2½%	10-2½%	15-2½%	7½-12½-5%
Bright	25-2½%	35-2½%	20-2½%	25-2½%	17½-12½-5%

Bar Iron—Prices are as follows in cents per pound at the places named:

	May 9, 1917	Six Months Ago
Pittsburgh, mill	3.75	2.50
Warehouse, New York	4.30	3.50
Warehouse, Chicago	4.50	3.25

Swedish (Norway) Iron—This material per 100 lb. sells as follows:

	May 9, 1917	Six Months Ago
New York*	$13.00@19.00	$6.00
Chicago*	8.75	5.75

*Stock very scarce.

Pipe—The following discounts are for carload lots f.o.b. Pittsburgh, basing card in effect May 1, 1917:

	LAP WELD				
2	42%	27½%	1¼	23%	....
2½ to 6	45%	35½%	1½	30%	....
			2	31%	....
			2½ to 4	33%	....
			4½ to 6	33%	....
	LAP WELD. EXTRA STRONG PLAIN ENDS				
2	40%	28½%	1¼	24%	8%
2½ to 4	43%	31½%	1½	30%	16%
4½ to 6	42%	30½%	2	32%	17%
			2¼ to 4	34%	20%
			4½ to 6	33%	20%

From New York and Chicago stock the following discounts hold:

	New York Black	New York Galvanized	Chicago Black	Chicago Galvanized
3½ to 6 in. steel lap welded	44%	28%	49%	49%
3½ to 6 in. steel lap welded	36%	18%	34%	34%

Malleable fittings, Class B and C, from New York stock sell at 5 and 5% from list price. Cast iron, standard sizes, 30 and 5%.

Cold Drawn Steel Shafting—From warehouse to consumers requiring fair-size lots, the following quotations hold:

	May 9, 1917	Six Months Ago
New York	List plus 25%	List plus 20%
Chicago	List plus 5%	List price

MISCELLANEOUS

Flotation Oils—New York prices of oils for flotation, in cents per gallon:

Pure steam-distilled pine oil	53½
Pure destructively distilled pine oil	48
Pine tar oil	23
Crude turpentine	38
Hardwood creosote	24

Hardwood creosote in Michigan costs 16c.

Sodium Cyanide—New York price is 37c. per lb.

Zinc Dust—New York price is 18c. per lb.

Calcium Carbide—Price f.o.b. cars at warehouse points east of Mississippi (except in Alabama) is $82.50 for Cameo, $87.50 for Union. In territory between Mississippi River and the Rockies and in Alabama, add $5; west of Rockies, add $10 to $15.

Rubber Belting—The following discounts from list apply to transmission rubber and duck belting:

Competition ..... 50-10% Best grade 25%
Standard 40-10%

Leather Belting—Present discounts from list in the following cities are as follows:

	Medium Grade	Heavy Grade
Chicago	40—5%	35—10%
New York	40—5%	40%

Rawhide Lacing—40%.

Packing—Below are prices each in cities named per pound:

Asbestos

		New York	Chicago
Valve and Stuffing Box	Twisted plain, 25-lb. cartons	$0.65@0.70	$0.80
	Twisted graphite, 25-lb. cartons	.80	.90
	Braided plain, 25-lb. cartons	.90	1.00
	Braided graphite, 25-lb. cartons	1.00	1.10

Asbestos wick in balls, ¼-, ½-, 1-, 25- and 50-lb. cartons, $0.65@0.70, New York; $0.80, Chicago.

Rubber asbestos, compressed sheet, medium grade about $0.80, New York, $0.93, Chicago.

Steam

Following in 25- and 50-lb. cartons:

First grade ..... $0.75 Second grade $0.50

Rubber and Duck

Higher grade ..... $0.40 Cold water $0.25

Piston

Asbestos, duck and rubber ... $1.25 Rubber and duck $0.90
Flax first grade ..... .85

Hose—	Fire	50-Ft. Lengths
Underwriters', 2½-in.		55@60c. per ft.
Common, 2½-in.		60% from list

Air

	First Grade	Second Grade	Third Grade
¾-in., per ft.	$0.45	$0.25	$0.18

Steam—Discounts from list

First grade..... 33⅓% Second grade..... 40% Third grade..... 50%

Manila Rope—Price in coils per lb. in cities named, ¾ to 1½ in.:

Boston	$0.27	Los Angeles	$0.23½
Cincinnati	.27	San Francisco	.25
Kansas City	.26½	Seattle	.26½
New Orleans	.26	Denver	.28
Chicago	.25½	New York	.28½

Railway Ties—For fair-size orders, the following prices per tie hold:

	Material	7 In. x 9 In. by 8 Ft. 6 In.	6 In. x 8 In. by 8 Ft.
New York	Yellow Pine	$1.15@1.20	$1.06@1.11
Chicago	White Oak	.95	.85

Cotton Waste—The following prices are in cents per pound:

	New York		Chicago
	May 9, 1917	One Year Ago	
White	13.00@15.00	11.00	13.00@15.00
Colored mixed	10.00@12.00	8.00	10.00@12.00

Linseed Oil—These prices are per gallon:

	New York		Chicago	
	May 9, 1917	Six Months Ago	May 9, 1917	Six Months Ago
Raw in barrels	$1.26	$0.94	$1.25	$0.95
5-gal. cans	1.36	1.04	1.30	1.05

Boiled, 1c. per gal. additional.

White and Red Lead, in cents per pound, sell as follows:

	Red				White			
	May 9, 1917		6 Months Ago		May 9, 1917		6 Months Ago	
	Dry	In Oil	Dry	In Oil	Dry and In Oil		Dry and In Oil	
100-lb. keg	11.25	11 50	10.50	11 00	11.00		10.50	
25- and 50-lb. kegs	11.50	11.75	10.75	11.25	11.25		10.75	
12½-lb. keg	11.75	12 00	11.00	11.50	11.50		11.00	
1- to 5-lb. cans	13.25	13.50	12.50	12.50	13.00		12.50	

Greases—Prices are as follows in the following cities in cents per pound for bbl lots:

	New York	Chicago	St. Louis
Cup	5@7	6	4⅝
Fiber or sponge	5@7	6¼	5⅝
Transmission	5@7	6¼	5⅝
Axle	3@4	3½	3 7/16
Gear	4@5	5	3
Car journal (S. & F.)	6½	4½	9½

Nuts—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York		Chicago	
	May 9, 1917	Six Months Ago	May 9, 1917	Six Months Ago
Hot pressed square	List	$0.50	$3.00	$3.00
Hot pressed hexagon	List	.50	3.00	3.00
Cold punched square	List	.50	2.50	2.50
Cold punched hexagon	List	.50	3.00	3.00

Semifinished nuts sell at the following discounts from list price:

	May 9, 1917	Six Months Ago
New York	50%	50—10%
Chicago	50%	50—10%

Machine Bolts—From warehouses at the places named the following discounts hold:

	New York	Chicago
⅜ by 6 in. and smaller	33⅓%	35—5%
Larger and longer up to 1 in. by 30 in.	20%	20—2½%

At this rate the net prices per 100 lb. follow:

	New York						Chicago		
	May 9, 1917			Six Months Ago			May 9, 1917		
Length, In.	¼	½	1	¼	½	1	¼	½	1
2	$1.19	$3 09	$12.80	$0.83	$2.32	$9.60	$1.10	$3.01	$12.43
2½	1.26	3.30	13.52	.89	2.84	10.14	1.15	3.22	13.18
3	1.28	3.50	14.24	.97	2.63	10.68	1 20	3.42	13.83
3½	1.36	3.71	15.16	1.01	2.97	11.22	1.24	3.62	14.59

Wrought Washers—From warehouses at the places named the following amount is deducted from list price:

New York ..... $4.00 Chicago $5.00

For cast-iron washers the base price per 100 lb. is as follows:

New York ..... $2.50 Chicago $3.00

Nails—Wire nails f.o.b. Pittsburgh sell at $3.50; galvanized 1 in and longer, $5.70; and shorter, $6.20. These prices are to regular customers and delivery is made at the mill's convenience. From warehouse, wire and cut nails sell as follows:

	Wire		Cut	
	May 9, 1917	Six Months Ago	May 9, 1917	Six Months Ago
New York	$3.85	$3 20	$4.50	$3.30
Chicago	3.65	2.95	3.65	3.05

EXPLOSIVES AND ACCESSORIES

Dynamite—Price in cents per pound at cities named:

	Low-Freezing	Gelatin Dynamite		
	20%	40%	60%	80%
New York	....	21¾	27¾	....
Denver	13¾	18¾	24¾	31¼
Los Angeles	18	26½	32	....
San Francisco	12½	17¼	23¼	30¼
Seattle	11¼	17	23	30

Prices per pound f.o.b. nearest railroad stations in Ohio, Indiana, Illinois, Michigan, Wisconsin and Dubuque County, Iowa, are as follows:

Low-Freezing Ammonia	Carload of 20,000 lb.	Ton Lots	200-Lb. Lots*
40%	15½	17	18¼
60%	19½	21	22¼
Low-Freezing Gelatin			
40%	18	19½	20¾
60%	25	25½	26¾

*Less than 200 lb., f.o.b. shipping point.

Blasting Powder—Price per keg:

		Carload Lots Delivered	Less Than Car Lots
Ohio, f.o.b. Columbus	400 kegs	$1.50	$1.80
Indiana, f.o.b. Aetna	800 kegs	1.55	1.80
Indiana, f.o.b. Indianapolis			1.80
Illinois, f.o.b. Chicago	400 kegs	1.57½	1.80
Iowa points on Mississippi River, f.o.b. St. Louis			1.80
Iowa points on Mississippi River, f.o.b. Fond du Lac			1.80
Missouri points on Mississippi River, f.o.b. Des Moines			1.85
Missouri points on Mississippi River, f.o.b. Saginaw			1.90
Michigan, So. Peninsula only, f.o.b. Kansas City			1.90
Iowa points not on Mississippi River, f.o.b. Duluth	800 kegs	1.60	1.90
Iowa points not on Mississippi River, f.o.b. Omaha			1.90
Missouri points not on Mississippi River	400 kegs	1.62½	
Wisconsin (except Counties of Ashland, Bayfield, Douglas, Florence and Iron)	400 kegs	1.70	
Minnesota, f.o.b. Minn. Transfer, Kansas City, Omaha	800 kegs	1.60	
Minnesota, f.o.b. Minn. Transfer	800 kegs		1.90
North and South Dakota, f.o.b. Bismarck			2.10
Nebraska, f.o.b. Omaha			1.90

Above prices are for CC, C, F, FF, FFF sizes. Price on FFFF size 5c. per keg advance over above prices.

Safety Fuse—Prices f.o.b New York, Chicago, per 1000 ft., less quantity discount:

Cotton	$6.65	Beaver	$6.75
Single tape	6.85	Anchor	7.65
Double tape	7.75	Crescent	7.65
Triple tape	8.60		

Blasting Caps—List price of blasting and electric blasting caps f.o.b. shipping points in states named:

	Electric Blasting Caps, Copper Wire					Blasting Caps	
	Price per 100						
	No.	4 Ft.	6 Ft.	8 Ft.	10 Ft.	No.	p. 1000
New York, Ohio, Indiana, Illinois, Kentucky and So. Michigan	6	$6.00	$7.00	$8.00	$9.00	5	$14.00
	8	8.00	9.00	10 00	11.00	6	17 00
						8	28.00
Missouri, Iowa, Minnesota, Wisconsin and No. Michigan	6	6.10	7.11	8 12	9.13	5	14.15
	8	8.10	9.11	10 12	10.13	6	17.15
						8	28.25
Kansas, Nebraska, North and South Dakota	6	6.15	7.16	8.17	9.18	5	14.30
	8	8.15	9.16	10.17	11 18	6	17.30
						8	28.55

CONSTRUCTION MATERIALS

Rosendale Natural Cement—Price to dealers for 500 bbl. or over, f.o.b., including bags:

New York $1.10

30c. allowed for bags.

Portland Cement—These prices are for barrels in carload lots including bags:

	May 9, 1917	One Month Ago	One Year Ago
New York	$2.40	....	$1.72
Chicago	....	2.16	1.86
Pittsburgh	....	2.16	1.81
San Francisco	2.00	2.60	2.30
Denver	2.89	2.89	.....

Brick—The price per 1000 in cargo or carload lots is as follows:

	Common			Paving	
	May 9, 1917	One Year Ago	One Month Ago	Brick	Block
New York	$11.50	$7 25	$9.50	....	....
Chicago	6.00	6.25	6.00	$16.00	$24.00
San Francisco	10.00	9.00	10.00	....	30.00
Seattle	7.00	....	7.00	....	28.75
Los Angeles	7.50	....	5.75	....	25.00
Denver	8.00	....	7.50	....	....

Lumber—Price per M in carload lots:

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and G., Dressed and Matched (10 In. x 16 Ft.)	
	Y.P.	Fir	Hemlock	Y.P.	Fir
Denver	....	$23.00	$23.00	....	$23.00
Seattle	$17 00	17.00	17.00	$17.00	17.00
Los Angeles	23.00	23.00	20.00	23.00	23.00
New Orleans†	35.00	30.00	....	40.00	33.00
Chicago	27.00	....	23.00	25.00	....
San Francisco	....	16.00	16.00	....	16.00

	8 x 8-In. x 20 Ft. and Under				12 x 12-In., 20 Ft. and Under	
	Y.P.	Fir	Hemlock	Spruce	Y.P.	Fir
Denver	....	$26.00	$26.00	....	....	$28.00
Seattle	$17.00	17.00	17.00	$17.00	$17.00	17.00
Los Angeles	....	23 00	20.00	....	23.00	23.00
New Orleans†	40.00	35.00	....	....	40.00	40.00
Chicago	27.50	34.00	25.00	....	31.00	34.00
San Francisco	....	16 00	16.00	....	....	16.00

†Cypress available instead of fir.

Roofing Materials—Prices per 100 lb. f.o.b. New York or Chicago.

Tar felt (14 lb. per square of 100 sq.ft)	$2.75
Tar pitch (in bbl. of 400 lb. each)	.60
Asphalt pitch (in bbl. of 400 lb. each)	3.25
Asphalt felt	1.40

Prepared Roofings—Standard grade rubbered surface complete with nails and cement costs per square as follows in New York and Chicago:

	1-Ply	2-Ply	3-Ply
No. 1 grade	$1.40	$1 65	$1.90
No. 2 grade	1.25	1.50	1.75

Asbestos roofing costs as follows:

2-ply ..... $2.25 3-ply ..... $3.25 4-ply $4.25

Asbestos asphalt saturated felt (14 lb. per square) costs $5.35 per 100 lb.

Slate surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.90 per roll.

Shingles, red and green slate finish, cost $4.85 per square.